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ABSTRACT

Sex equity is an issue which many feel that teachers should be aware of in each area of the curriculum. The intent of this training module is to bring the issues of sex equity in the classroom to the conscious level of each teacher of science. The purposes of the module are to: (1) provide educators with increasing awareness of sexual bias in teaching science and to offer techniques/activities addressing these biases; (2) provide tools to promote the participation of women in science; (3) offer materials and strategies for educators designed to increase students' confidence and competence in doing science; and (4) relate the usefulness of science to future career choices. Most of the document consists of handouts, which include: a "Women Scientists" game; a "Famous Women Scientist Word Search"; "Women in Science" (a list containing thumbnail sketches of women scientists through the ages); "Build the Highest Tower" (an exploration of creative problem solving); a series of "Science Equity Session Plans"; a list of "Science Activities for Classroom Use"; and lists of resources for teachers. Various trainer instruction sheets are also provided, including an evaluation form. Included also are lists of transparencies and materials needed. (CW)

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SE Lan.

Equity in Science

A TRAINING MODULE

Developed by

Alaska Department of Education
Office of Curriculum Services

and

Anchorage School District
Community Relations Department

Funded by

Title IV Sex Desegregation
Technical Assistance Grant

and

Anchorage School District

EQUITY in education

THE ALASKA PROJECT

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
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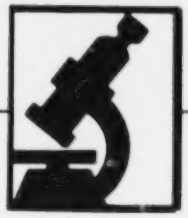

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ACKNOWLEDGEMENTS

The development of the Equity in Science Module (K-6) has been a collaborative effort requiring the cooperation of the Anchorage School District personnel and the Alaska State Department of Education. Those who worked on the development of this module are:

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October, 1987

INTRODUCTION TO THE MODULE SERIES

Alaska's sex equity law, which prohibits sex discrimination in public school education, was passed by the Alaska Legislature in 1981. The law has been cited as one of the strongest state sex discrimination laws in the nation. This is in part due to the fact that the regulations require school districts to establish written procedures:

1. for the biennial training of certificated personnel in the recognition of sex bias in instructional materials and in instructional techniques which may be used to overcome the effects of sex bias;

2. for the biennial training of guidance and counseling staff in the recognition of bias in counseling materials and in techniques which may be used to overcome the effects of sex bias;

3. for the review of textbooks and instructional materials for evidence of sex bias; and

4. for the replacement or supplementation of materials found to exhibit bias.

Since the implementation of these regulations, referred to as Chapter 18, many school districts have relied on the Department of Education to provide them with on-site inservice training in the area of sex discrimination. Recognizing that local school districts need their own cadre of equity trainers as well as materials, the Department of Education utilized Title IV funds for the development of a series of equity modules. During the summer of 1986, educators within Alaska developed six modules, relating directly to curriculum content areas, that are now available to all Alaskan school districts. The modules were developed and written in such a fashion that district personnel with a minimal amount of experience could conduct an equity inservice.

Modules which have been completed include:

Women in American History (Elementary)
Women in American History (Secondary)
Language Bias (K-12)
Science (Elementary)
Mathematics (Elementary)
Computer Equity (K-12)
Foreign Languages
Fine Arts (Elementary)

The Department is continuing the development of modules in other curriculum areas.

The Department of Education is committed to helping school districts comply with the regulations outlined in Chapter 18.

School district personnel using the modules are requested to complete the evaluation sheet and return it to the Department of Education. This information will be used to update and improve the modules.

TITLE: SCIENCE EQUITY

PURPOSE: To emphasize to educators the many continuing aspects of bias and discrimination in our society in order to provide continuous positive change in the educational environment.

GOAL: To provide educators the opportunity to focus on sex equity issues related to the teaching of science.

LEARNING OBJECTIVE	METHOD	TECHNIQUE	TIME	ACTIVITY	RATIONALE	RESOURCES NEEDED
1) Participants will become acquainted with each other and Trainer, also discuss and receive clarification on the intent of inservice and clarification on purpose of the activities.	Large Group (Small Group Optional)	Information giving. Question/ answers.	10 minutes	Introduction of participants to facilitator and facilitator to participants.	To allow for open questioning and reviews of goals and objectives.	Name tags Markers Flip Chart Handout #1 Transparency #1 Overhead Projector
2) Participants will develop a greater awareness of their personal perceptions of a scientist and relate this understanding to the classroom.	Individual Small Group Large Group	Small group discussion.	35 minutes	Visualize a scientist	To recognize our own biases in science and the effects in the classroom.	Pencils 8 1/2"x11" paper Crayons, colored pencils, or markers Flip Chart Transparency #2 Tape Overhead Projector
3) Participants will identify and list problem areas in teaching science to girls, and provide solutions to assist in making science teaching more equitable.	Individual Small Group Large Group	Individual & small group generating ideas. Large group sharing of generated ideas.	30 minutes	Problems and solutions.	To identify local problems and to identify effective strategies and solutions in science teaching.	Acetate marker Overhead Projector Transparency #3 & #4 Handouts #2 A-D Flip Chart Felt Pens

LEARNING OBJECTIVE	METHOD	TECHNIQUE	TIME	ACTIVITY	RATIONALE	RESOURCES NEEDED
4) Participants will acquire knowledge of women of historical importance in the scientific profession.	Individual Small Groups	Individuals generating names of people in science. Small groups playing card game.	25 minutes	Women scientists.	To increase awareness of women in science	Pencils/pens Paper Flip Chart Set of women scientist cards Handouts #3, #4, #5 Transparency #5
5) Participants will explore creative problem solving by using non-traditional materials to build a structure.	Small Groups	Small groups working cooperatively to build the highest tower	30 minutes	Build the highest tower.	To discover ways to encourage enthusiasm in science.	For each group: 2 pieces of paper 10 paper clips Scissors Masking tape Marking pens Handout # 6
6) Participants will formulate two lessons each to use in their classrooms to promote equity in science.	Individual Small Groups	Individuals and small groups working cooperatively to formulate lessons for their classrooms.	40 minutes	Future planning.	To relate the experiences of the workshop to their classrooms.	Pencils Handouts #7 A-K Handout #8
7) Participants will be exposed to additional science activities to be used in the classroom.	Large Group	Individuals receive additional activities for use in the classroom	5 minutes	Distribution of classroom activities	To take back more science activities for the classroom.	Handout #9

LEARNING OBJECTIVE	METHOD	TECHNIQUE	TIME	ACTIVITY	RATIONALE	RESOURCES NEEDED
8) Participants will receive a list of resources available to classroom leaders.	Large Group	Individuals receive listing of classroom resources & share their own resources.	10 minutes	Distribution of additional resources	To receive ideas for further resources	Handouts #10, #11, #12, and 13 (optional)
9) Participants will provide feedback on workshop.	Large Group	Individuals will complete evaluation form.	5 minutes	Evaluation Chart	To provide feedback on workshops to trainees	Handout #14

MODULE CONTENT

TITLE: Equity in Science

CONTACT TIME: Three hours

TARGET AUDIENCE: K-3 teachers

HANDOUTS: Copy prior to workshop:

#1	Agenda
#2 A-D	Research - Interest and Attitude
#3	Women Scientists Game
#4	Famous Women Scientists Word Search
#5	Women in Science
#6	Build the Highest Tower
#7 A-K	Science Equity Session Plans
#8	Sample Lesson Plan Format
#9	Science Activities for Classroom Use
#10,11,12	Resources for Teachers
#13	Main and Supplemental Science Kits (For Anchorage School District only)
#14	Evaluation

TRANSPARENCIES:

#1	Why All This Science?
#2	Pictures of Scientists
#3	Boys Become Doctors
#4	Girls Become Nurses
#5	Women Scientists

MATERIALS:
Name tags
Markers
Flip Chart
Overhead Projector
Pencils/Pens
8 1/2"X11" white paper
Crayons, colored markers or colored pencils
Tape
Acetate Markers
Paper Clips
Scissors

NOTE TO TRAINER: Handout #3 includes game cards which need to be cut out prior to the workshop. Read and be familiar with the module contentprior to the beginning of the workshop.

OVERALL DESIGN AND PURPOSE FOR EQUITY IN SCIENCE INSERVICE

Science, as with any subject area, should be integrated as much as possible into the curriculum. Sex equity is an issue which teachers should be aware of in each area of the curriculum. It is the intent of this module...Sex Equity in Science Education...to bring the issues to sex equity in the classroom to the conscious level of each teacher of science. With these insights into the issues of sex equity, it is more specifically the intent to ensure sex equity in the classroom.

SCIENCE EQUITY

PURPOSE:

1. To provide educators with increasing awareness of sexual bias in teaching science, and to offer techniques/activities addressing these biases.
2. To provide tools to promote the participation of women in science.
3. To offer materials and strategies for educators designed to increase students' confidence and competence in doing science.
4. To relate the usefulness of science to future career choices.

AGENDA

Time	Activity
10 minutes	Introductions and Agenda Sharing
35 minutes	Visualize a Scientist
30 minutes	Problems & Solutions
10 minutes	Break
25 minutes	Women Scientists
30 minutes	Build the Highest Tower
30 minutes	Lesson Plans
5 minutes	Science Activities for Classroom Use
10 minutes	Additional Resources for Teachers
5 minutes	Evaluation

INTRODUCTIONS AND AGENDA SHARING

PURPOSE: To share with participants who you are; to establish a climate where people feel included; to set norms; and to share with participants your expectations about the purposes and agenda for this training session.

GROUP SIZE: 10 to 30 people

TIME REQUIRED: Approximately 10 minutes

MATERIALS:
Name tags (if appropriate)
Handout #1
Flip Chart
Transparency #1
Markers
Overhead Projector

ROOM ARRANGEMENT: Large group setting, informal

PROCEDURES: (Individual trainers have their own style of introducing a workshop. These are some suggestions and rationale for choosing to do certain things.)

1. Place cartoon Transparency #1 on overhead projector so participants can see it as they arrive.

2. Trainer will have participants introduce themselves to each other.

   Optional: Have each person in room introduce self. If you are working with staff from more than one school, you may wish people to say what school they are from and their position.

   Optional: We have found name tags help us associate names with faces. It also helps participants if they are not all from the same school.

3. a. Trainer gives background of the inservice - tells where it was developed and shares how it came to be offered to that school (or district or group). Sex Equity in Science Education was developed during the summer of 1986 by one educator working for the Community Relations Department of the Anchorage School District.

b. Trainer also points out that Chapter 18, Alaska's Sex Equity Regulations, requires biennial training of staff in the areas of sex bias and sex role stereotyping. This inservice satisfies that part of the law which mandates inservice training, under Chapter 18, for teachers.

4. Trainer distributes Handout #1 or goes over agenda on flip chart.

5. Trainer asks for clarification questions or concerns. Example:

   "What do you expect from the workshop?"
   "Is there anything confusing about the agenda?"
   "Do you have any concerns?"

6. Trainer will post this pre-written goal.

   Goal:

   To insure sex equity in the science classroom by heightening the consciousness and improving the teaching methods of classroom teachers and aides who teach science.

OVERALL DESIGN AND PURPOSE FOR EQUITY IN SCIENCE INSERVICE

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AGENDA

Introductions and Agenda Sharing

Visualize a Scientist

Problems & Solutions

Break

Women Scientists

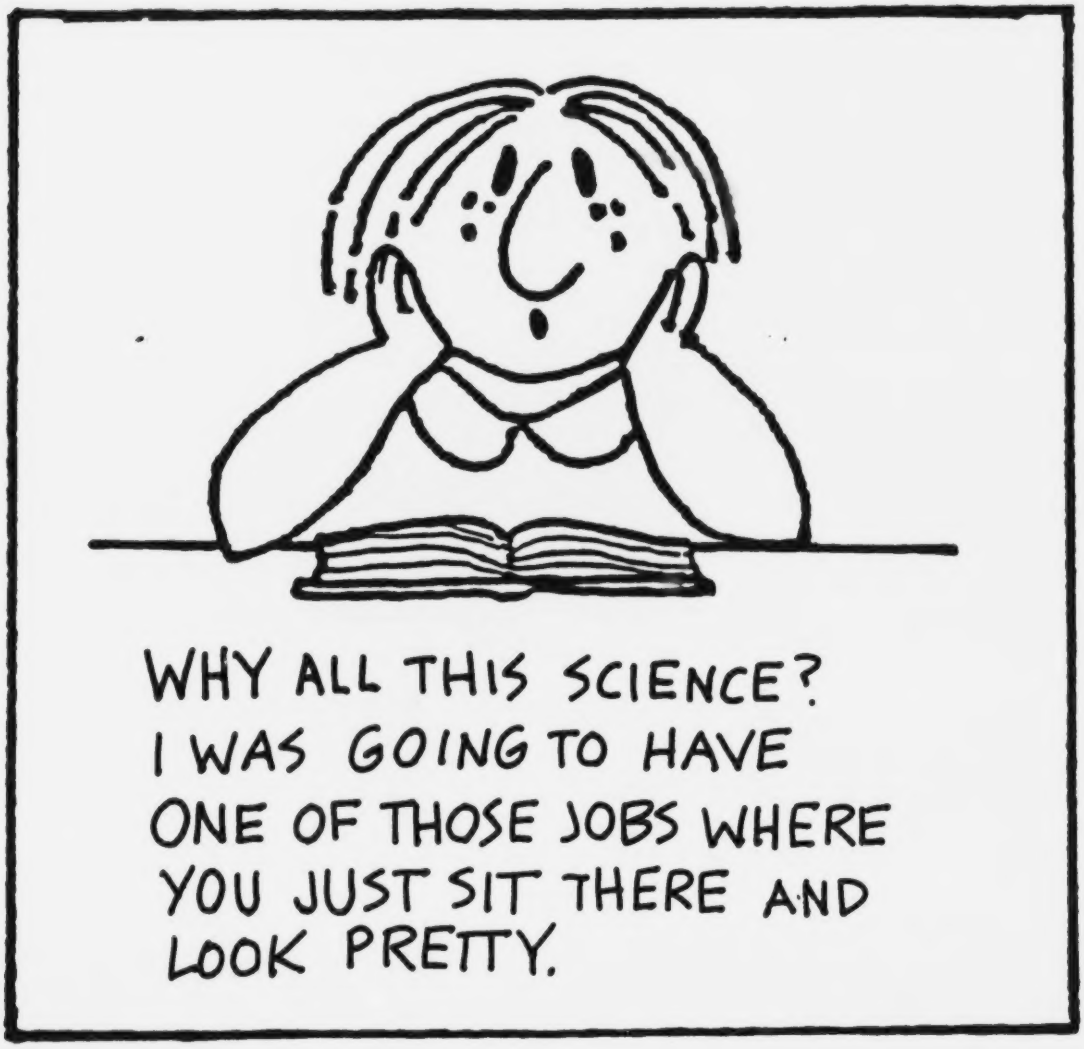
Build the Highest Tower

Lesson Plans

Science Activities for Classroom Use

Additional Resources for Teachers

Evaluation


WHY ALL THIS SCIENCE?
I WAS GOING TO HAVE
ONE OF THOSE JOBS WHERE
YOU JUST SIT THERE AND
LOOK PRETTY.

VISUALIZE A SCIENTIST

PURPOSE: Lead participants to an awareness of their perceptions of a scientist.

GROUP SIZE: Small discussion groups (4-5 per group)

TIME REQUIRED: 35 minutes

MATERIALS:
Pencils
8 1/2" x 11" white paper
Crayons, colored markers or colored pencils
Flip Chart
Transparency #2
Overhead Projector
Tape

ROOM ARRANGEMENT: Individual and small group setting, work tables.

PROCEDURE:

1. Pass out materials (paper, pencils, colors).

2. Trainer asks each participant to close their eyes and relax. Ask them to visualize a scientist. Slowly talk them through as you say:

   "Visualize a scientist. Visualize the hair. The eyes. The nose. The mouth. The chin. Any other facial characteristics. What is the scientist wearing? Where is the scientist located? Continue to visualize your scientist completely. When you are ready, open your eyes and draw your scientist." (10 minutes)

3. When the drawings are complete, form a group of 4-5 and discuss your scientist. Are the scientists stereotyped? Mostly, white, Black, other? Male, female? Old, young? Show transparency to group. Ask "Do any of your pictures look like this?" (10 minutes)

4. Share findings from each group with the group as a whole. Discuss any significant results. Write on flip chart to hang on wall.

   Example: <u>Visualize a Scientist</u>

   a. Most scientists were men/women.
   b. Most were older/younger.
   c. Etc.

5. Discuss as a whole group the ways these findings may affect a classroom. What results might they obtain in their classroom? (5 minutes)

6. Go back to your classes and try it!

TRANSPARENCY #2

RESEARCH ACTIVITY

PURPOSE: To review the literature relating sex equity to science.

To discuss and determine a variety of approaches to assist in making science teaching more equitable.

GROUP SIZE: Small discussion groups (4-5 per group)

TIME REQUIRED: 30 minutes

MATERIALS:
Overhead Projector
Acetate Markers
Transparencies #3 and #4
Handouts #2 A-D
Flip Chart or Newsprint
Felt pens

ROOM ARRANGEMENT: Small group setting, work tables

PROCEDURES:

1. Show cartoon Transparencies #3 and #4, "Boys Become Doctors" and "Girls Become Nurses."
2. Trainer asks participants to form four groups with equal number possible, of participants in each group.
3. Trainer asks groups to select recorder; passes out newsprint and felt pens.
4. Trainer asks recorder to list the five most interesting or significant findings which impact the classroom that they would like to share with the rest of the group.

   Note: Do not be alarmed if the group does not agree with the findings, allow time to express their opinions either positive or negative on the research.
5. Trainer passes out one set of research findings to each group.

   Group 1=A Group 3=C
   Group 2=B Group 4=D
6. Trainer allows 10 minutes for groups to review and record their findings.

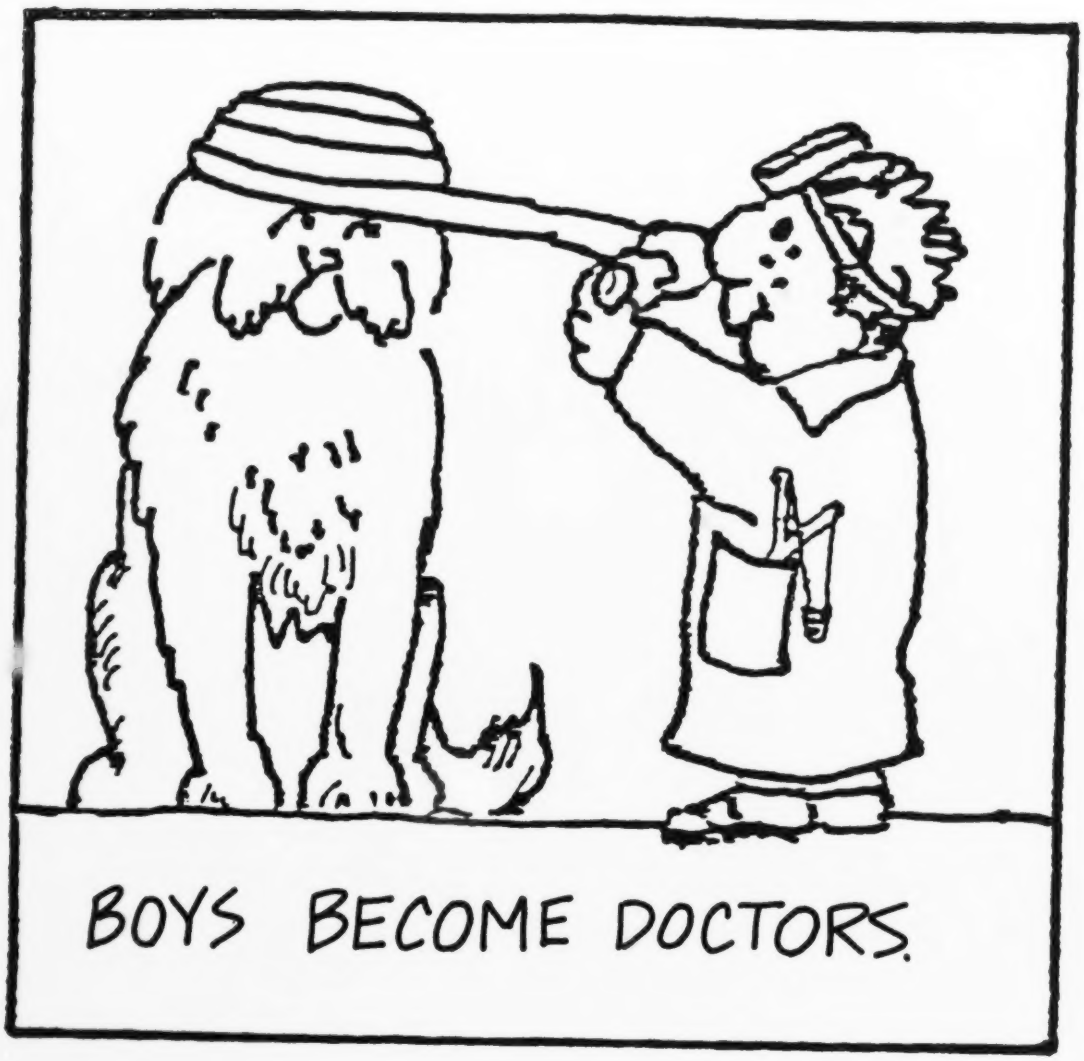
7. After the end of 10 minutes, the Trainer allows time for each recorder to share the group's findings. Encourage participants to discuss if the research proves true in their classrooms or other classrooms they have observed.

8. Trainer may wish to bring closure to the activity by having the group identify problems which block girls from becoming active in science, then the group will offer solutions. Example:

The Problem	Solutions
Girls are not as motivated as boys in science.	1. Give more encouragement. 2. Praise girls for science and math abilities. 3. Activities for the entire class.

Use brainstorm techniques to seek alternative solutions.

(25 minutes)


BOYS BECOME DOCTORS.

TRANSPARENCY #4

RESEARCH - INTEREST AND ATTITUDE

"Interest in science is related to achievement."
Bloom (1976)

"Increasing the interest and participation of women and racial minorities in mathematics and science majors and careers continues to be an issue of national concern." (National Science Foundation, 1984)

"Students who have a high level of interest in mathematics and science are more likely to pursue mathematics and science majors and to persist in these fields than are students who have lower interest levels." (Maines, 1983; Thomas 1984)

"Race and sex differences in students' interest in, and affinity for, mathematics and science have been reported in a number of studies (Fox, 1976; Berryman, 1983; Chipman and Thomas, 1984). The findings from these studies indicate that Black and female students express lower levels of interest and affinity for mathematics and science than white and male students." (Thomas, Gail E.)

"Students acquire a dislike for science courses early. By the end of the third grade, almost 1/2 of all students feel they would not like to take science; by the end of the eighth grade, only 1/5 have a positive attitude toward science." (Science and Mathematics in the Schools)

"Elementary school girls like science and math as much as boys do. Female students begin to lose their interest in science and math in their early teens." (Adding a Woman's Touch, p. 25)

RESEARCH - ABILITY

"When girls succeed in science, they credit luck. When boys do well, they credit ability. Why?"

"Women attribute their failures to their lack of ability, while men attribute their failures to other causes." (Reyes, Laurie Hart and Padilla, Michael J., Science, Math and Gender, the Science Teacher, p. 48, September 1985)

"It has been reported that the extent to which students like math and science and pursue college majors and careers in these fields is largely a function of the academic ability and mastery that students exhibit in these fields." (Werts, 1966, Astin and Panos, 1969, Benbow and Stanley, 1980)

RESEARCH - PEERS

"Picou and Carter (1976) found that peer modeling and peer encouragement have a significant effect on educational aspirations of students. Peer influence has also been found to have an effect on school outcomes in science. Howe and Durr (1982) reported that planned peer interactions during chemistry laboratories increased student understanding of abstract concepts. Keeves found that attitudes toward science were strongly influenced by friends who participated in math and science activities. He concluded that the peer group with which a student spends his or her leisure time would be expected to influence personal attitudes toward science and math. Attitude toward science is contagious...both in a positive, as well as in a negative manner." (Talton and Simpson)

RESEARCH - PRAISE AND ENCOURAGEMENT

"The extent and nature of teacher praise affects students' attitudes towards mathematics and science. For example, Kaminski (1976) reported that teachers readily assume that girls like reading and dislike math and science. Teachers subsequently encourage girls and boys differently based on this assumption." (Thomas)

RESEARCH - ADULT ROLE MODELS

"Having early exposure to and access to relevant role models and receiving adequate encouragement from 'significant others' (i.e., parents, teachers, counselors, and peers) also have been reported as important factors that influence students' interest and attitudes towards mathematics and science. Malcom, Hall and Brown (1976) and Young and Young (1974) found that exposure to, and interaction with, professional role models in the natural and technical sciences are critical for recruiting and retraining students' interest and participation in mathematics and science." (Thomas, p.32)

"Positive family attitudes and encouragement also have been reported as important factors for recruiting and retaining students' interest and participation in math and science. For example, Fox (1976) found that at a very early age, girls, but not boys, are told that having children is a responsibility that will interfere with their occupational careers. Thomas (1984) and Malcolm (1976) also reported that Blacks and females receive less encouragement to pursue college majors and careers in mathematics and science than do whites and males." (Thomas)

RESEARCH - SCIENCE CLUB PARTICIPATION

"Providing students with greater access to informal mathematics, science education, and extracurricular activities has been identified as an additional strategy for increasing their interest in math and science." (Fox, 1982; Fisher, 1983; Kahle, 1983) This could be accomplished through informal interaction with parents and older siblings, attending museums, participating in math games and math and science clubs.

RESEARCH - HOBBIES

"It has been reported that having an affinity for mathematics and science hobbies and engaging in such hobbies during childhood are positively related to students' subsequent interest in mathematics and science education and careers. (Kahle, 1983) Also, students with high educational and occupational expectations have been reported as having favorable attitudes toward mathematics and science than students with low educational and occupational expectations. Young (1983) and Steel (1978) also noted that female and Black students are socialized very early in their educational development to be more 'affective' and 'service oriented' and less 'analytical' and 'quantitative' in their career interests and aspirations. As a result, these students express less competitive and lower occupational expectations than do males and whites. Young and Young (1974), Thomas and Gordon (1983) and Gottfredson (1977) However, females and Blacks express comparable and sometimes higher educational expectations than do males and whites." Thomas, Alexander and Eckland, (1979), Thomas (1979), (Thomas, p.34)

The results from Thomas show that having an interest in science hobbies has the strongest positive relationship to interest in high school science for males and females. For females, the next two most important factors are:

1. having received encouragement to major in science, and
2. performance on standardized tests.

For males they are:

1. childhood aspirations of being a scientist, and
2. high school grades.

RESEARCH - BENEFITS OF SCIENCE EDUCATION

"Ruth Wellman cites 18 studies which found that direct first-hand manipulative experiences in science enhanced the development of process skills in young children in kindergarten to third grade and had a positive correlation with their success in beginning language and reading achievement."

"Wellman cites a dozen studies which point to benefits children can derive from science instruction. Included are vocabulary enrichment, increased verbal fluency, increased ability to think logically, and improved concept formation and communication skills." (p. 7)

"Barafaldi and Swift note that the deficit in science teaching in the elementary school is often the consequence of teachers' sincere, but misguided, notion that they are too busy teaching more important things, such as reading and language arts. If they knew that the results of research indicate a positive relationship between children's participation in activity-centered science programs and the development of oral language skills and reading readiness, perhaps science would get a greater share of their attention." (Mechling, Oliver)

RESEARCH - TEACHERS CAN HELP

"Within schools, the most important influence on science and math learning is the teacher. Teachers can influence students' attitudes about themselves and about science and mathematics." (Reyes, Laurie Hart and Padilla, Michael J., Science, Math and Gender, The Science Teacher, p. 48, September 1985.)

"Teachers interacted more with high-achieving boys than with high-achieving girls in a class of seventh graders." (Reyes, L. H. Classroom Processes, Sex of Student, 1981)

Confidence is crucial and we must plan lessons so that the self-fulfilling prophecies of failure are broken!

We must evaluate closely what we expect from our male and female students and try to eradicate the myth that males are naturally better than females in math and science.

We must convince our female students that science is useful.

Study real-life problems such as environmental concerns or energy issues. Examine the science of everyday living...bicycles, cooking, athletics.

"The extent and nature of teacher praise affects students' attitudes towards mathematics and science. For example, Kaminski (1976) reported that teachers readily assume that girls like reading and dislike math and science. Teachers subsequently encourage girls and boys differently based on this assumption." (Thomas)

"The nature of science, the tool we use to describe and order our environment, requires that we teach it through concrete, hands-on experiences." (What Research Says, p.50)

Subtle behaviors which occur; try to avoid:

... Interrupting girls more frequently than boys or allowing them to be disproportionately interrupted by others in class.

... Calling directly on boys more often than girls.

... Asking questions followed by eye contact with male students only, as if only boys were expected to respond.

... Addressing the class as if no females were present, or using classroom examples in which the professional is always "he," the client or patient always "she."

... Overlooking women when, for example, talking informally with students, nominating students for awards or prizes.

RESEARCH...WOMEN IN SCIENCE: A LONG ROAD

Consider:

.. Less than 14% of all math and science Ph.D.'s are women.
.. Only 6% of all professional engineers are women.
.. Less than 3% of the nearly 1,400 members of the National Academy of Sciences are women.

Statistics indicate that women are not adequately represented in the math and science fields, and, according to a recent study by Teresa G. Monger of the Department of Petroleum Engineering at Louisiana State University, they will continue to be underrepresented. "Women who go into the male-dominated engineering field experience a lot of stress, and maybe that's why the numbers aren't growing more rapidly," speculates Monger. "Maybe we should be discussing why engineering isn't attractive or worth the struggle for some women."

Monger, who based her study on statistics from a salary survey of 250 engineering schools and freshman college enrollment figures, suggests that better information campaigns are needed to reach girls in grade school and high school.

A few schools and institutions have made some strides: Mount Mary College in Milwaukee sponsors a program to enable high school girls to learn about career opportunities in math and science, for example; and IBM awards grants to several pre-college and college programs geared toward women who want to enter the field. But for the most part, institutions have been slow to provide encouragement.

It doesn't get easier once a woman is in the field either, says Vivian Gornick, author of Women in Science: Portraits from a World in Transition (Simon and Schuster, 1983). Once women get to the top scientific positions, Gornick told a Rutgers University lecture audience recently, they don't get the same raises men do. And in 1980, twice as many women were unemployed in the field as men. There's a little hope, though. In the earliest days of female scientists, women were not allowed to express differences in style or personality. That, Gornick says, is starting to ease up.

RESEARCH...GIRLS AND SCIENCE: THE GAP REMAINS

All those textbook pictures of girls performing science experiments, the women's movement and a general push to improve education have not erased the difference in boys' and girls' achievement in science, according to the second International Science Study. The study measured U.S. students' knowledge of science in grades five, nine and 12, and is comparing it with that of students in 24 other nations, as well as with the performance of U.S. pupils in 1970. The international comparisons will not be available until 1986.

On the domestic front, however, today's students showed a modest improvement over their 1970 counterparts. Of particular note was their improvement on questions requiring so-called "process skills," as distinct from simple recall of facts. This shift matches a change in the emphasis in commercial science-education programs, which have been paying much more attention to "higher-order thinking skills."

But the difference in performance between girls and boys, which was significant in 1970, is still significant today. Moreover, the difference between boys' and girls' scores increased as they moved through their school years. The differences were greatest in the physical sciences. In the fifth grade, for example, boys did better on items dealing with the correct placement of batteries in a flashlight and the reason a thrown ball comes back to the ground.

This kind of finding, which persisted and intensified up through the grades, suggests that girls could profit from more experience with physical materials, according to Willard J. Jacobson of Columbia University's Teachers College and Rodney L. Doran of the State University of New York at Buffalo. Jacobson and Doran are coordinating the U.S. part of the study.

---Susan Walton

RESEARCH...SCIENCE, MATH and GENDER

by Laurie Hart Reyes and Michael J. Padilla

WHEN GIRLS SUCCEED IN SCIENCE, THEY CREDIT LUCK. WHEN BOYS DO WELL, THEY CREDIT ABILITY. WHY?

Many girls simply have not been keeping pace with boys in secondary science. High school girls are less likely to study science and are not as confident as boys about their abilities in science [6]. They become more discouraged than boys about low science grades [2]. The data about girls and science accumulates, but data is not enough. We must analyze this new information and what it tells us about how we can improve. We must change the way we teach if we want to see more women in science careers in the coming decades.

So let's examine some recent data on the topic of sex-related differences in science and math achievement. Why math as well? Because math and science are learned together. In order to consider science as a career, women must have adequate math preparation; and that brings us back to our consideration of sex-related differences in achievement.

A recent meta-analysis of almost 300 studies sheds more light on gender differences in science. In those studies boys achieved better than girls in science and had more positive attitudes toward science. In elementary school, the analysis showed, boys did just a bit better than girls in science, with an effect size of 0.04 [5]. (An effect size is a difference stated in standard deviation units. A difference of 0.04 is very small.) By middle school the effect size had risen to 0.32 in favor of boys.

In another meta-analysis, researchers described several findings [10]:

.. Girls say they believe strongly that science is not just for boys. However, girls are less likely than boys to identify with science, to select science as a career, or to choose science-related activities.

.. Girls prefer life sciences, boys physical sciences. Girls like chemistry better than boys do, however.

.. During the last 6 years the gap between boys' and girls' motivation toward science has increased. Both groups show more interest in science, but boys' motivation has increased more than girls'.

A familiar source of information, the National Assessment of Educational Progress-Science (NAEP-S), has yielded two new insights. A recent reinterpretation of the assessment results attributed differences between boys' and girls' science knowledge

to traditional gender roles [11]. Men seem to know more about technology, applied science, and other topics traditionally associated with men. Women seem to know more about such traditionally female topics as health, child development, and nutrition.

Girls are reluctant to guess on tests, and that made a difference in the NAEP-S results, according to another reanalysis [1]. Girls chose the response "I don't know" more often than boys did. That could mean that females avoid taking risks in science. "Not guessing avoids being right or wrong. Females, more than males, in this culture seem to be afraid of being wrong," the researchers suggested.

Sex-related differences in mathematics and science achievement develop over years, through the student's interaction with family, school, and society. We need much more research before we can know the causes of the differences. We cannot ignore the influences of family and society, but students learn mathematics and science mainly in school. On what should we concentrate if we want to have an impact on the way girls learn science?

Variable in space

The only important cognitive variable that may affect sex-related differences is spatial visualization, the menial manipulation of three-dimensional objects. We usually measure spatial visualization by tasks such as matching a picture of a cube with the correct two-dimensional drawing of the unfolded cube. Two pieces of evidence lead us to believe that this variable contributes to sex-related differences in math and science begin to appear. Second, it seems likely, although unconfirmed by research, that topics such as geometry, physical science, and graphing require spatial visualization skills.

Affective variables, such as students' attitudes about science, about the study of science, and about themselves as learners, may also be related to sex differences in mathematics and science performance. Students who are sure they can learn advances material are more likely to attemps to learn it; and the more they attempt, the more likely students are to learn. Several studies have confirmed the link between achievement and confidence. One study found that in every case where there was a significant difference between the mathematics achievement levels of girls and boys that favored boys, the boys also expressed more confidence in their ability to learn mathematics [3, 4]. Even then girls and boys achieved at the same level, the girls expressed less confidence in their ability to learn mathematics. Girls' confidence levels started dropping in 6th grade and continued to drop relative to boys' until 12th grade. Confidence in 8th grade proved the strongest predictor of 11th grade math achievement for boys and girls [8]. Math confidence can also predict future enrollment in math courses [9]. In science, we've already seen that girls are reluctant to guess at answers - an example of low confidence.

Another affective factor in the differences between girls' and boys' science and math performance may be whether or nor student think the subject is useful. In one study, when sex differences in perceived usefulness of math existed, a sex difference in math achievement also existed [3, 4]. If students don't see science as part of their career or life, they probably won't perform as well as they would if they saw science as pertinent. Students who do not think science important probably will not even opt to take science courses in high school. As early as middle school, more boys than girls rate mathematics as useful.

Stereotypes that label science and math as male may also affect

performance. These stereotypes, including media images that show only men as users of science, influence parents' expectations for their children and students' expectations for themselves.

The last of the affective factors sets u pa no-win situation for women. Women more often attribute success to effort and luck, while men attribute success to their ability. On the other hand, women attribute their failures to lack of ability, while men attribute their failures to other causes. What does this mean? If a student thinks she has failed because of lack of ability, she is less likely to work harder to improve than will a student who believes he has failed because he didn't try hard enough. Conversely, when a student does succeed, if she attributes her success to luck, she is not encouraged by the success.

What about Teachers?

We have considered characteristics of the students - cognitive and affective variables. But what characteristics of schools, classrooms and teachers might contribute to sex differences?

One study found sex differences in math achievement only in some schools [3, 4}. The differences did not seem to be related to the socioeconomic status of the students. The researchers hypothesized that the cause of the differences might lie partly within individual schools.

Within schools the most important influence on science and math learning in the teacher. Teachers can influence students' attitudes about themselves and about science and mathematics. On researcher noted that teachers interacted more with high-achieving boys than with high-achieving girls in a class of seventh graders. This was true of interactions teachers initiated and ones students indicated. [7}

Middle grade teachers must realize the pivotal role these grades play. The middle years are often the last during which all students are required to take mathematics and science courses. So we need to examine critically what and how we teach. Middle grade teachers must remember how important confidence is and plan lessons so that the self-fulfilling prophecies of failure are broken.

We must evaluate closely what we expect from out male and female students and try to eradicate the myth that males are naturally better than females in math and science. Any we must convince out female students that science is useful. Studying real-life problems such as environmental concerns or energy issues can help, as well as examining the science of everyday living - bicycles, cooking, athletics. Enthusiastic teachers who examine and reexamine their attitudes and expectations of male and female students, and who take special care to encourage girls, can help make sure that science becomes an equal opportunity employer.

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WOMEN SCIENTISTS

PURPOSE: Participants will acquire knowledge of women of historical importance in the scientific professions.

GROUP SIZE: Small groups (3-5 per group)

TIME REQUIRED: 25 minutes

MATERIALS:
Pencils/Pens
Paper
Flip Chart
Set of women scientist cards (copied & cut prior to training).
Handouts #3, #4, #5
Transparency #5

ROOM ARRANGEMENT: Individual and small group setting, work tables.

PROCEDURE:

1. Ask the participants to write the names of 10 famous scientists. Allow 5 minutes.
2. Ask them to share their scientists with the group. Trainer will write the names on chart paper.
3. Determine the number of men and the number of women listed.
4. "This next activity will help us all acquire knowledge of women in the scientific professions." Pass out the instruction sheets and cards to each group. Have each group read the directions and begin when they are ready.
5. After 10 minutes have elapsed, ask the participants to stop and collect the cards into one pile from each group.
6. Ask if they learned of any women scientists. Ask if this game could be used in their classrooms. Ask how it could be adapted for various grade levels.
7. Distribute Handout #4 which is a Word Search using several names of scientists for your use in the classroom.
8. Distribute Handout #5. These are several pages of information on women in science and medicine which can to be used as resources for adapting your own games.

9. Trainer shares information on Transparency #3 with participants as a closure for this activity.

Women Scientists

Skills
- *Reading*
- *Memorizing*
- *Recognizing patterns*

Time
- *1 class period*

Participants
- *Groups of 3–5 students*

Materials
- *36 playing cards for Women Scientists game*

For centuries, women scientists have been unknown to most people, and their names and histories are unfamiliar. In this activity, students acquire knowledge of women of historical importance in the scientific professions.

Preparation:

Duplicate and cut one set of 36 cards for each group of 3–5 students. Form student groups for a typical card game.

Directions:

Women Scientists is a "Go Fish" kind of card game made up of three information cards on each of 12 women in history who made contributions to scientific and technical fields. The object of the game is to lay down the most "books"; each book consists of three cards that are about the same woman scientist.

In each group, a student shuffles the cards and stacks them, face down, on the table. Each player in turn draws a card, reads it aloud, and keeps it in his or her hand. When a player whose turn has come has a card which he or she remembers is similar to one held by another player, the player whose turn it is may ask for the card before drawing. If the request is correct, the card (or cards) must be given to the requesting player and the player may continue to ask for cards. If the request is incorrect, the player asked replies, "Go take another science course." The requesting player then draws from the pile. If the card just asked for is drawn, the player gets another draw.

Each card that is drawn from the stack must be read aloud before the player places the card among the cards in his or her hand. Any player who notices that another player forgot to read the card may claim it, read it, and keep it as part of his or her hand. Players may lay down any complete books they have at the end of their turn. The play continues until all cards are used. The player with the most books wins.

Ellen Swallow did outstanding work in chemical analysis.

Contributions to physics, especially in the area of sound and elasticity, were made by Sophie Germain.

To discourage Sophie Germain from studying late at night, her parents took away her sources of heat and light.

A famous mathematician tried to get Emmy Noether a place on the faculty of a German university saying, "After all, we are a university, not a bathing establishment."

Emmy Noether altered the course of albegra by her work.

In 1900 Emmy Noether, mathematician, was one of two women among the 1,000 students enrolled in her university.

The first woman ever invited to join the American Academy of Sciences was Maria Mitchell, astromer.

In 1847, Maria Mitchell sighted the first comet ever discovered by telescope.

Maria Mitchell, astromer, started the association for the advancement of women in 1873.

Since women were not admitted, Marie Curie could not attend the University of Warsaw.

An outstanding black woman space scientist, Katherine Johnson, has worked on spacecraft such as the earth resources satellite.

Sophie Germain worked in number theory, and won several prizes for her work in mathematical physics.

Mary Somerville, mathematician, developed the beginning steps toward the concept of conservation of energy.

The prediction of the existence of the planet Neptune was made possible by Mary Somerville's work.

The interconnection of physical forces is founded on Mary Somerville's work.

The first Native American woman doctor in the United States was Susan La Flesche.

Susan La Flesche was the daughter of a chief of the Omaha Indian tribe.

After graduating from medical school, Susan La Flesche returned to practice medicine among her people, the Omaha Indian tribe.

Chien Shiung Wu (Chee en She ung Woo) was promoted to full professor of physics at Columbia University and became the seventh woman member of the U.S. National Academy of Sciences.

When there were no female students allowed at Princeton, Chien Shiung Wu (Chee en She ung Woo) was invited to teach nuclear physics there in 1943.

Chien Shiung Wu (Chee en She ung Woo) designed an experiment that helped earn the Nobel Prize in Physics in 1957.

Because she was a woman, Sonya Kovalevski was denied admission to the French Academy of Sciences.

In 1874, after producing outstanding work in mathematics, Sonya Kovalevski received her Doctorate from the University of Gottingen in Germany.

Sonya Kovalevski made important contributions to the study of the shape and behavior of Saturn's rings.

Margaret Mead wrote *Coming of Age in Samoa* and other studies of South Sea societies.

Margaret Mead, anthropologist, studied primitive and modern societies.

By studying other cultures, Margaret Mead helped us to understand our own culture.

Even though she had discovered radium and polonium, Marie Curie was refused admission to the French Academy of Sciences.

The first person in the world ever to win two nobel prizes was Marie Curie.

Rebecca Lee received her medical degree in 1864 from the New England Female Medical College.

After the Civil War, Rebecca Lee returned to the South and established her medical practice in Richmond, Virginia.

The first black woman doctor in the United States was Rebecca Lee.

Katherine Johnson was a recipient of a group achievement award presented by NASA's Lunar Spacecraft and Operations Team.

Katherine Johnson, space scientist, studied the mathematics and physics of spacecraft travel.

Devoting her life to studying and teaching about healthful environments, Ellen Swallow popularized the word ecology.

The first woman admitted to M.I.T. was Ellen Swallow, but she was denied the Doctorate in Chemistry there because she was a woman.

FAMOUS WOMEN SCIENTISTS WORD SEARCH

C S R A C H E L C A R S O N
A D C H P B R L S G T A R N
R R Q E A A M T Q I K O V Y
O R Q R Q B A D P R V Z T U
L S P T K P S S A L J M H I
I L X H O M C O D L S B B S
N C L A R A B A R T O N E L
E W J A D R N C E M O D N S
H X Y Y O I V W F X R H E Q
E M A R I E C U R I E W D X
R H G T T S E G F I K J I G
S I E O F T V G D V P E C R
C T U N K O E S P D Q H T Y
H L S Z A P J V A H T F I Z
E M C B S E C W S O O C H T
L A E D N S U S H C S R R M

Look in the puzzle for the following. Names only appear in puzzle.

HERTHA AYRTON -- Physicist and inventor

CLARA BARTON -- Founder of Red Cross

RUTH BENEDICT -- Anthropologist

RACHEL CARSON -- Marine Biologist

MARIE CURIE -- Scientist

CAROLINE HERSCHEL -- Astronomer

MARIE STOPES -- Botanist and Zoologist

WOMEN IN SCIENCE

Maria Agnesi: Italian (1718-1799)

One of the most brilliant Italians of the 18th century, she was appointed professor of mathematics at the University of Bologna. In 1748 she published Analytical Institutions for the Use of Italian Youth, a mathematics text book on algebra, analytical geometry and calculus which was widely translated.

Dr. Elizabeth Garrett Anderson: British (1836-1917)

First woman to qualify as a doctor in Britain and have a hospital named after her. (Inspired by a lecture in 1859 by Dr. Elizabeth Blackwell.)

Hertha Ayrton: British (1854-1923)

Physicist, suffragette and inventor. She invented a line-divider which is still used by architects, and also worked on the electric arc-solving problems to do with lack of stability and noise; her book on the subject, published in 1902, led to defense work for the Admiralty on search lights.

Dr. James Barry: British (1795-1865)

One of the most astonishing of all careers. Born a woman, "he" successfully disguised his sex all his life, and had a long career as a doctor with the British army.

Clara Barton: American (1821-1912)

"The angel of the battlefield," she was virtually an unpaid quartermaster to the wounded of the Civil War, and founded the American Red Cross. She was an almost exact contemporary of Florence Nightingale, and resembled her not only in her work on the battlefield, but also in her refusal to retire until her nineties despite frail health.

Ruth Benedict: American (1887-1948)

She introduced the concept of "patterns of culture" to the discipline of social anthropology. She became deaf as a child. She was 32 before she began studying anthropology.

Dr. Elizabeth Blackwell: British (1821-1910)

She was the first woman in the United States to qualify as a doctor. She was a strong advocate of common sense and preventive medicine.

Rachel Carson: American (1907-1964)

She was the marine biologist whose analysis of the harm done to the cycle of nature by pesticides led, after her death, to the banning of the use of DDT in the United States, and alerted both scientists and general public all over the world to the necessity of protecting the environment.

Edith Cavell: British (1865-1915)

A famous martyr of the First World War, she was a heroic British nurse shot by Germans for obeying the humanitarian principles of her training.

Gabrielle Emilie du Chatelet: French (1706-1749)

She was a hardworking mathematician and philosopher, who translated Newton's Principia Mathematica into French and wrote the introduction. She also introduced the mathematical ideas of the German philosopher Liebniz to France.

Evelyn Cheesman: British (1881-1969)

She was a distinguished entomologist and collector of insects and was largely self-taught.

Elena Cornaro: Italian (1646-1864)

She became Europe's first woman doctor of philosophy.

Marie Curie: Polish (1867-1934)

She was the first world-famous woman scientist and discovered the element radium. She twice won a Nobel Prize, first with her husband and Henri Becquerel in Physics, then alone in Chemistry. Her work led directly to the treatment of cancer with radium.

Rosalind Franklin: British (1920-1958)

She was the crystallographer whose x-ray photographs of the molecular structure of DNA - the protein-building "brick" from which living cells are built up - were a principal clue in the unravelling of DNA's famous "double helix" in 1953 for which several scientists won the Nobel Prize for Medicine in 1962.

Jane Goodall: British (1934-)

She is virtually the founding mother of ethology, the scientific study of the behavior of animals in the wild.

Catherine Greene: American (1731-1793?)

Eli Whitney is always given sole credit for the invention of the cotton gin. In fact, the idea for the machine was given to him by Catherine Greene when he was staying in her house. Women were not then allowed to apply for patents!

Caroline Herschel: German (1750-1848)

She was the astronomer who discovered three nebulae and 18 comets.

Dorothy Hodgkin: British (1910-)

She is the x-ray crystallographer who won the Nobel Prize for Chemistry in 1964 for analyzing the structure of Vitamin B_{12}, a vital substance in the fight against pernicious anemia.

Karen Horney: American (1885-1952)

She was the first Freudian psychoanalyst to reject Freud's view of feminine psychology as a defective version of masculine psychology. She founded the Association for the Advancement of Psychoanalysis, the only independent school of psychoanalysis to be founded by a woman.

Hypatia: Egyptian (c.370-415)

She was one of the most popular and admired teachers of the Hellenistic world. She was a mathematician, astronomer, and philosopher, and became a professor at Alexandria, teaching the views of Plato and Aristotle.

Dr. Elsie Inglis: British (1864-1917)

She said, "I have two passions in life, suffrage and surgery." She was famous for the field hospitals she organized in France and Serbia during the First World War, having no governmental support.

Barbara Ward Jackson: British (1914-)

She was a brilliant writer on economics and a committed ecologist.

Dr. Aletta Jacobs: Dutch (1854-1929)

She was Holland's first woman physician and opened the world's first birth control clinic in Amsterdam in 1882.

Dr. Sophia Jex-Blake: British (1840-1912)

She was one of the first woman doctors in Britain.

Elizabeth Kenny: Australian (1886-1962)

She pioneered physiotherapy treatment for children crippled by poliomyelitis. She opened her own hospital in South Queensland.

Dame Kathleen Kenyon: British (1906-1978)

She made history as the archaeologist who rewrote the prehistory of Middle Eastern townships by digging up Jericho and Jerusalem. In the 1930s she helped found London's Institute of Archaeology, becoming its acting director.

Melanie Klein: Austrian (1882-1960)

She was an important figure in the development of the psychoanalytic understanding of children and infants. Her great contribution was the development of a technique for analyzing young children's play as an insight into their emotional development. She wrote several books.

Dr. Dorothie Leporin: German (1715?-1762)

She was a midwife and obstetrician and wrote "On the Reasons Which Keep Women Back From Higher Education."

Dame Kathleen Lonsdale: British (1903-1971)

She was the finest x-ray crystallographer of her generation and one of the first two women to be elected to the Royal Society in 1945. She wrote "Is Peace Possible," as well as many scientific publications, and lectured all over the world.

Ada Lovelace: British (1815-1852)

She was an exceptionally gifted mathematician. She foresaw, over a century ahead of her time, how a digital computer would work.

Anna Manzolini: Italian (1716-1774?)

She was celebrated throughout Europe for the wax models she made of different organs of the body and became professor of anatomy at the University of Bologna.

Jane Marcet: Swiss (1769-1858)

She refused to believe that science was beyond the understanding of ordinary people and set an educational fashion with her "Conversations On ..." series.

Mary the Jewess: Egyptian (c.AD50)

She was one of the early alchemists who worked in Alexandria on the chemistry of metals and invented the water-bath, or bain-marie. The method ensures moist, even, gentle heat.

Margaret Mead: American (1901-1978)

The first person to make anthropology comprehensible to ordinary people. Her great contributions were to show that societies existed where adolescence was not a traumatic, rebellious phase, and that "human nature" and "sex roles" are not the same the world over, but incredibly varied.

Lise Meitner: Austrian (1878-1968)

She was an eminent physicist who pioneered the splitting of the atom, but refused to make the atom bomb.

Maria Sebylla Merian: German (1647-1717)

She was an exceptionally gifted entomologist and botanical illustrator who showed the way to the proper classification of species.

Maria Mitchell: American (1818-1889)

She was a great scientist, teacher and astronomer and the first woman to be elected to the American Academy of Arts and Sciences.

Lady Mary Wortley Montagu: British (1689-1762)

She introduced vaccination against smallpox to England.

Florence Nightingale: British (1820-1910)

She was the founder of modern nursing and the famous "Lady of the Lamp" in the Crimean War.

Marguerite Perey: French (1909-1975)

She discovered the element actinium K, which she called francium in honor of her country. She was the first woman to become a member of the Academie des Sciences in 1962.

Dixie Lee Ray: American (1914-)

She is a scientist and was elected the first woman governor of Washington in 1977.

Margaret Sanger: American (1883-1966)

She was a nurse and the pioneer of birth control in the United States.

Dr. Regina von Siebold: German (1771-1859)

She was one of the first European women to be granted an academic degree in gynecology.

Mary Somerville: British (1780-1872)

She was a mathematician and astronomer of international standing. She was one of the first women to be elected to the Royal Astronomical Society in 1835.

Marie Stopes: British (1880-1958)

She received degrees in botany and zoology and became the first woman lecturer at Manchester University.

Trotula: Italian (c. AD1100)

She was the most famous of the women teachers of medicine at Europe's first university at Salerno.

Dr. Mary Walker: American (1832-1919)

She was an army surgeon and won the Congressional Medal of Honor for her care of the wounded during the American Civil War.

Chien-Shuing Wu: Chinese (1912-)

She became professor of physics at Columbia University in 1944. Her most important contribution is her experimental proof that contrary to accepted theory, similar nuclear particles do not always act similarly.

"Women have always practiced the arts of healing. It seems only to have been for three or four centuries, when medicine first became institutionalized, that they were virtually barred from working as doctors or surgeons. Yet there were women doctors in ancient Egypt, in classical Greece and Rome, and in the Middle Ages. In England even as late as the 16th century, women were permitted to enter the examinations which would allow them to practice medicine, and dozens are known to have passed and been licensed. However, attitudes changed and women became effectively excluded from the profession. It was not until the mid-19th century, in the face of considerable opposition, that women once again won the right to train and qualify as doctors. A similar story is true of the other sciences."

(Women of Achievement)

In reading the literature on famous women in science and medicine, several aspects ran through most of their lives. The first - most had a parent or significant other who was a role model for their future career choice. The second - many of those decided upon their career choice early in life. The third - many, if not having a parent whom they chose to follow, were inspired by others, via lectures or personal meetings. The fourth - most had a long, hard struggle to be accepted in a man's world.

BUILD THE HIGHEST TOWER

PURPOSE: Participants will explore creative problem solving.

Participants will discover ways to encourage enthusiasm in science.

GROUP SIZE: Small groups (4-5)

TIME REQUIRED: 30 minutes

MATERIALS:
2 pieces of paper for each group
10 paper clips for each group
1 pair of scissors for each group
Masking tape and marking pen to measure towers
Handout #6

ROOM ARRANGEMENT: Each small group will need a work area to build their tower. This could be on tables or on the floor.

PROCEDURE:

1. Pass out the materials to each group.
2. Read the directions:
   a. Only the materials provided may be used in building your tower.
   b. The towers must be free-standing. They may not lean against the wall or be held up.
   c. Towers must be brought to the tape on the wall for measuring. This means they will have to be transportable or easy to rebuild at the measuring site.
3. Divide participants into groups and assign a working area.
4. If they ask questions, merely repeat the original instructions. The intent is to minimize instructions so they will be encouraged to invent innovative ways to build the tower.
5. Discuss how this activity relates to girls/boys in problem solving. Were there differences in how males/females solved the problem in your group?
6. After the activity has been completed, discuss ways in which this activity could be used in the classroom.

TAKEN FROM: SPACES - Solving Problems of Access to Careers in Engineering and Science, Dale Seymour Publications

HANDOUT #6
Distribute AFTER Activity

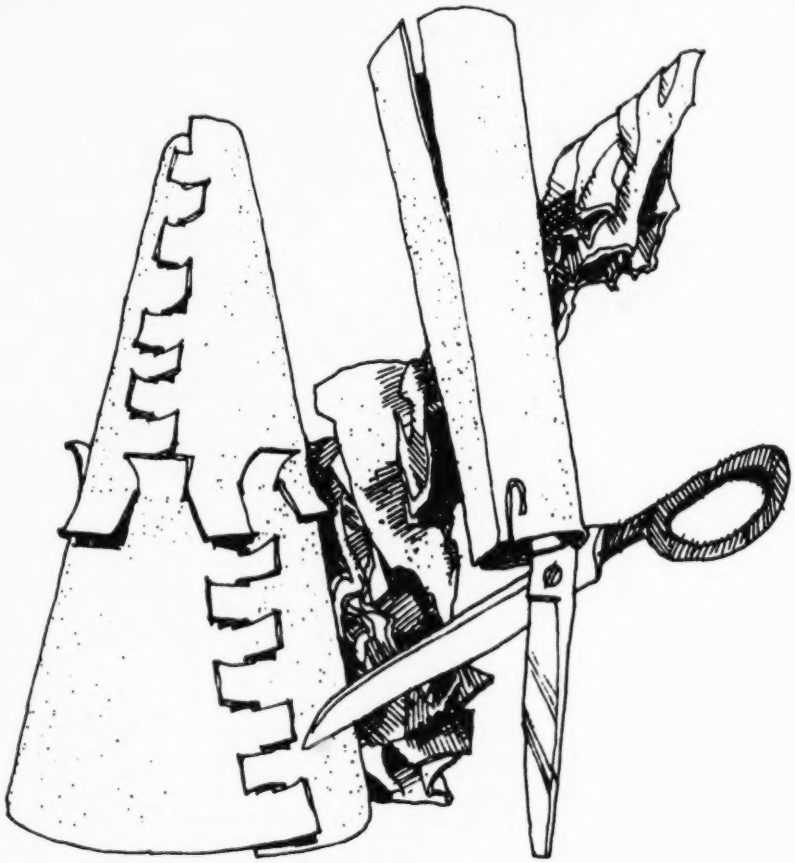
Build the Highest Tower

Skills
- *Brainstorming*
- *Cooperating*

Time
- *1 class period*

Participants
- *Groups of 2–4 students*

Materials
- *8½" × 11" paper*
- *Paper clips*
- *Scissors*
- *Masking tape*
- *Marking pen*



Students explore creative problem solving by using non-traditional materials to build a structure. The challenge is to build the highest tower using these materials.

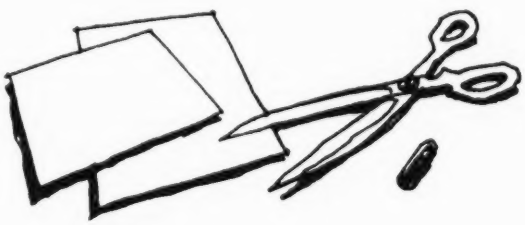
Preparation:

1) Divide the materials into sets consisting of:

2 pieces of paper

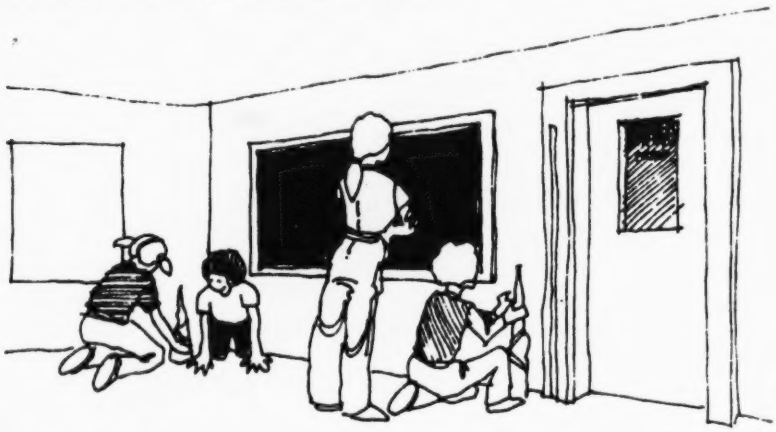
10 paper clips

1 pair of scissors



You will need a set for each group of students.

2) Apply a strip of masking tape to a wall or door jamb starting at the floor and extending up about 5 feet. This will be used to compare the heights of the towers.



Directions:

Give these directions to the students:

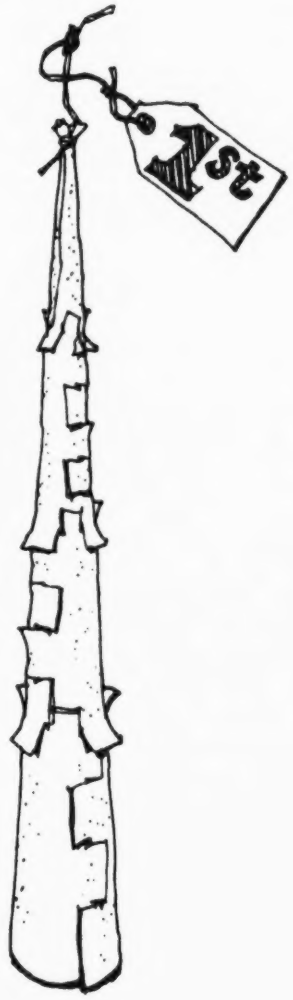
- Only the materials provided may be used in building your tower.
- The towers must be free-standing. They may not lean against the wall or be held up.
- Towers must be brought to the tape on the wall for measuring. This means they will have to be transportable or easy to rebuild at the measuring site.

Divide the students into groups and assign a working area for each group of students. Distribute sets of materials and let the students start building.

Some questions may arise, such as, "Can we tear the paper?" or "Can the scissors be part of the structure?" The best response is to repeat the beginning instructions, without giving further information. The intent is to minimize instructions so students will be encouraged to invent innovative ways to build the tower.

As pairs of students finish their structures, have them bring the towers to the measuring site. Write the initials or names of students beside their tower's mark on the tape.

When all towers have been measured, announce the winners. You may want to discuss with the class some of the successful or not-so-successful strategies used to hold the towers together and upright.



Extensions:

Allow time for experimentation. Give the students 15 minutes to experiment with scratch paper before they actually begin building their tower.

DEVELOPING SCIENCE LESSON PLAN

PURPOSE: To have participants formulate plans for his/her own classroom.

GROUP SIZE: Individual and small group. (Some will prefer to work on their own, others may wish to share ideas within grade levels.)

TIME: 40 minutes

MATERIALS: Handouts #7 A-K (one each)
Handout #8 (two for each group)

PROCEDURE:

1. Trainer has participants group together in threes or fours by grade levels, subject areas, or interest groups.

2. Trainer explains that in few moments one member from each group will come up to examine lessons & other materials designed to be used with students in a classroom situation. If the member from the group chooses a sample lesson, than the group must do one of the following:

   a. Adapt the lesson so it can be used by a different grade level; or
   b. Design a follow up lesson to the one they have chosen; or
   c. Design an introductory lesson to the one they have chosen.

3. Trainer instructs the participants to write the new lessons clearly on the supplied format sheet, Handout #8. Each group should be given two format sheets...one for a working copy, and one to turn in to be copied. The plans will be duplicated and left in a central location at the school as a resource for anyone interested. Trainer distributes Handout #8.

4. Trainer allows time for one person from each group to come to the table and choose a sample lesson.

5. Trainer asks if there are any questions and allows participants 15 minutes to develop a new lesson.

6 At the end of 15 minutes, Trainer has one person from each group briefly summarize the lesson plan they have been given and the lesson they have developed.

7. Trainer asks for a volunteer to copy two sets each of the lesson plans, one to remain at the school.

NOTE TO TRAINER: If this session is being held at a site in the Anchorage School District, collect a set of the newly created lessons and send to:

Anita Robinson
Community Relations Department
Administration Building

If this session is being held at a site other than the Anchorage School District send a set of the newly created plans to:

Sex Equity Coordinator
Department of Education
P.O. Box F
Juneau, AK 99811-0500

If funds permit, the lessons will be compiled into a resource guide and distributed to school districts throughout the state.

LESSON PLAN

DO YOU LIKE SCIENCE?
#1 - SCIENCE AND YOU

ACTIVITY A: Your Feelings About Science

PROCEDURE: In this unit you are first going to look at your attitudes and beliefs about science and yourself.

Later, you will find out how you have formed your attitudes. You will study the factors that have helped shape you. These factors are your genes, your natural environment, and your social environment. (You will find out what these words mean later in the unit.)

Finally, you will make decisions about your values and attitudes in relation to yourself and science.

Read the statements below. Write T next to a statement if you think it is true. Write F if you think a statement is false. This test will not affect your grade. Your answers should be what you believe - not what you think your teacher or other people might believe.

A-1 Boys are naturally better at science than girls are.

A-2 Girls are too emotional to make good scientists.

A-3 Boys usually get better grades in science than girls do.

A-4 Men make better scientists than women do.

A-5 Most scientists are men.

A-6 Science is interesting.

A-7 Science doesn't affect our everyday lives.

A-8 Knowledge of science can help people make better decisions about their lives.

A-9 Scientists are usually geniuses.

A-10 Only a few jobs are related to science.

A-11 Heredity (the traits people get from their parents) is the main thing that determines people's feelings about themselves.

A-12 Environment (people's surroundings) is the main thing that determines people's feelings about themselves.

A-13 People's feelings about themselves affect the decisions that they make.

ACTIVITY B: Class wrap-up

B-1 What were your answers for A-1 through A-5? What do the results show about the attitudes of the class? Where do you think these attitudes come from?

B-2 What were your answers to A-6 through A-10? What do the results show about the attitudes of the class? Where do you think these attitudes come from?

B-3 What were your answers for A-11 through A-13? What are you going to find out in this unit? Which of these factors interest you? Why?

LESSON PLAN

DO YOU LIKE SCIENCE?
#2 - HOW IS SCIENCE USED?

ACTIVITY A: What is Science About?

What do you think scientists do at work? Here is a list of some types of work scientists do.

... Find out how alcohol affects the body.

... Discover ways to prevent diseases like polio and measles.

... Try to decide when earthquakes are likely to occur.

... Find ways to make water safe to drink.

... Grow new types of corn that taste better and don't get attacked by harmful insects.

... Find better ways to use the sun to heat and cool houses.

... Discover how to make a gasoline engine.

Some of the activities listed above were done in the past. Scientists are still working on others. Imagine yourself as a scientist. Which one of the above activities sounds the most interesting to you as a project? Why?

ACTIVITY B: What Are Jobs Like in Science and Technology?

Science is a way of trying to understand our universe better. We ask questions about our world. Then we try to answer the questions. We read, observe, and experiment. We then try to find answers that fit the information we have gathered.

The use of scientific information for human needs is called technology. For example, if you study electricity, you are a scientist. But if you use your knowledge of electricity to make a television set, you are a technician or technologist. As you can see, science and technology have a lot in common.

Look at the pictures in B-1 through B-5. Under each picture is a quote from a person who works in an area of science or technology. Read each quote. Then try to match the job described in the quote with one of the jobs listed below each picture. If you have trouble with a word, look up the definition.

Rank order B-1 through B-5, according to your own opinion, from most interesting job to least interesting job.

ACTIVITY C: Class Wrap-Up

C-1 In Activity A, you chose the scientific activity which sounded the most interesting to you. Why did you choose that activity? How many other people in your class chose the same activity? Why did they choose their activities?

C-2 Discuss your answers for Activity B. Tell which jobs you chose as most interesting and least interesting and why. Give at least one reason that you think you would like or dislike the job.

C-3 Was there a difference in the way boys and girls in your class answered C-1 and C-2? Many females seem not to want to be scientists and technologists. Why do you think this happens? What can be done to change this situation?

C-4 Do you think it is important for everyone to study science? Why or why not?

"I work for an oil company. We are exploring the ground beneath the Gulf of Mexico to find oil. Many of the wells we drill never produce any oil. These wells are expensive to build. For this reason, we use tests to increase the chances of finding a good oil field.

"I work for a private company, but I still feel as though I'm working to help people. After all, everyone is hurt by lack of oil."

B-1 What person does this kind of work?

a. biologist
b. chemist
c. physicist
d. laboratory technician
e. geologist
f. engineer

"I work on a team. In general, we try to find cures for different forms of flu. We have already had some luck in making vaccines for a few kinds of flu. But there are still many more cures we haven't discovered yet.

"We test drugs on mice that have a flu virus. In this way we find out whether the drug cures the disease without harming the mice. Then we decide whether the drug will work for people as well. Many tests will be done before the drug becomes a medicine for people."

B-2 What person does this kind of work?

a. biologist
b. physicist
c. geologist
d. engineer
e. oceanographer
f. nurse

"I work with cities and towns that are growing rapidly. I help them plan when and where to build shopping centers and roads. This way, the city's growth won't harm the water supply or create flooding problems.

"I mainly study problems with the water supply. But other scientists work with the towns, too. They decide what the new plans could do to wildlife, air, and traffic flow."

B-3 What person does this kind of work?

a. biologist
b. environmental scientist
c. laboratory technician
d. physicist
e. chemist
f. astronomer

"I work in a hospital. Each day I do many tests on samples of people's blood and urine. Some things I test for are amount of sugar in the blood, amount of blood in urine, and number of white blood cells. I record the information and give it to the doctor. The doctor uses it to help determine what is wrong with the patient."

B-4 What person does this kind of work?

a. nurse

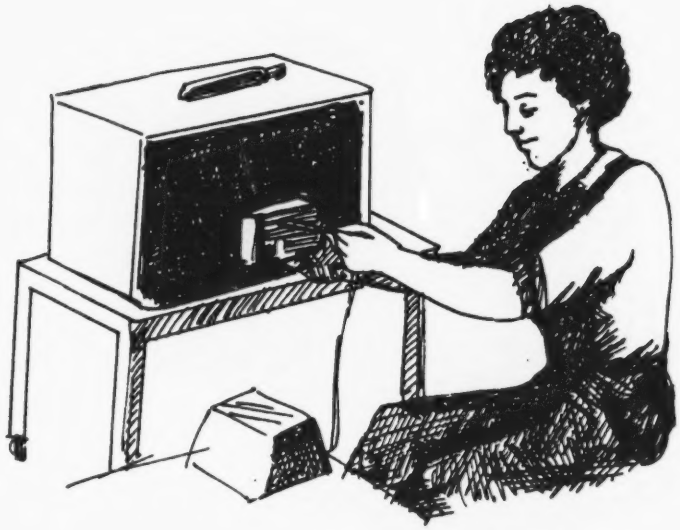
b. physicist

c. physician

d. environmental scientist

e. geologist

f. medical technologist



"Most people don't know how to repair their television sets, so they depend on us. In school we studied electricity as one part of our training.

"If I didn't understand electricity, I could still fix some things that go wrong with television sets. But since I do understand electricity, I can fix more difficult problems. I'm glad I learned a lot about electricity. This way, I can do a better job for my customers."

B-5 What person does this kind of work?

a. physicist
b. television technician
c. television reporter
d. chemist
e. medical technologist
f. engineer

LESSON PLAN

DO YOU LIKE SCIENCE?
#3 - DOES SCIENCE AFFECT YOUR LIFE?

ACTIVITY A: Humans Visit the Moon

Many people remember July 20, 1969, as the first time human beings visited the moon.

Do you think that going to the moon was important? Or do you think that it was a waste of money?

Below is a list of products that all have something in common. Read the list of items carefully.

... fireproof clothing for infants

... girdles

... home-insulation materials

... pots and pans

... heart monitors

... pacemakers for infants

... radio transistors

... ball bearings

What do these products have in common? They were all invented or improved upon as a result of space research - like the trip to the moon.

In fact, since 1968, over 63,000 products have been developed as a result of space research.

Do you think your life is easier because of science? Has your life become worse in some ways because of science? To think about these questions, do Activity B.

ACTIVITY B: Does Science Help Solve Problems?

Jobs in science can be exciting! People in these jobs are trying to solve all kinds of problems. Some of these problems are very important to people.

B-1 Write down two inventions or cures that you would like to see occur in your lifetime. Would you like to work on a scientific team that tries to make the invention or cure you listed?

B-2 As a class, make a list of as many important cures or inventions as possible. From the list, choose three you think you know the most about or are the most interested in. From the choices, your teacher will choose one problem. The class will discuss this problem in the next assignment.

B-3 Before the class discussion begins, you may need to do some library research about the topic chosen. As you do your research, think about the following questions:

a. What kinds of information would scientists need to know to solve the problem?

b. What kinds of scientific or technological jobs would be used in finding the answer to the problem?

c. How might the answer to the problem affect your life?

Here is an example of an invention and several answers to the questions above. This might help you as you research and think about the class topic.

INVENTION: I would like scientists to find a substitute for gasoline to make cars run.

a. Kinds of information needed:

1. What resources - other than gasoline - can produce power?

2. Can those other resources provide power to cars as well as gasoline can?

3. Can we make new forms of energy to run cars?

b. Kinds of jobs needed to find the answer:

1. geologist
2. physicist
3. chemist
4. engineer
5. biologist
6. mechanic

c. How the solution might affect my life:

1. Twenty years from now, gasoline will be much harder to buy. But with the new power resources, I might be able to drive as much as I like.

2. If no new power resources are developed within the next 20 years, I might have to limit my driving greatly.

ACTIVITY C: Science and Your Life (discussion)

C-1 Use the questions listed in B-3 for the cure or invention you have chosen. Think of as many ideas as you can to answer the questions.

C-2 What are some ways science and technology have affected your life? Which inventions of technology have had a negative (bad) effect? A positive (good) effect?

ACTIVITY D: Technology and More Technology

Do one or both of the following:

D-1 Make a collage of things created by technology that affect your life.

D-2 Make a list of things created by technology that you think affect people's lives in a negative way. Present your list to the class.

LESSON PLAN

DO YOU LIKE SCIENCE?
#4 - WHO IS LIKELY TO BECOME A SCIENTIST?

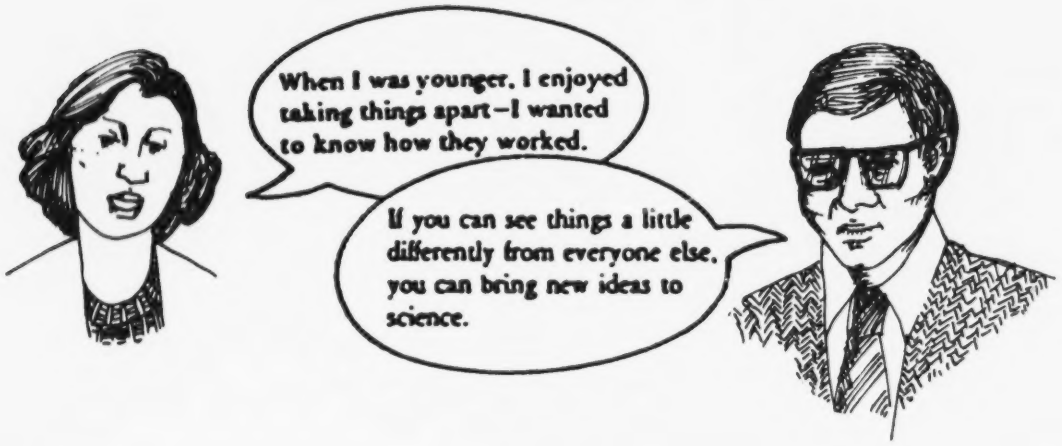
ACTIVITY A: What Makes a Scientist?

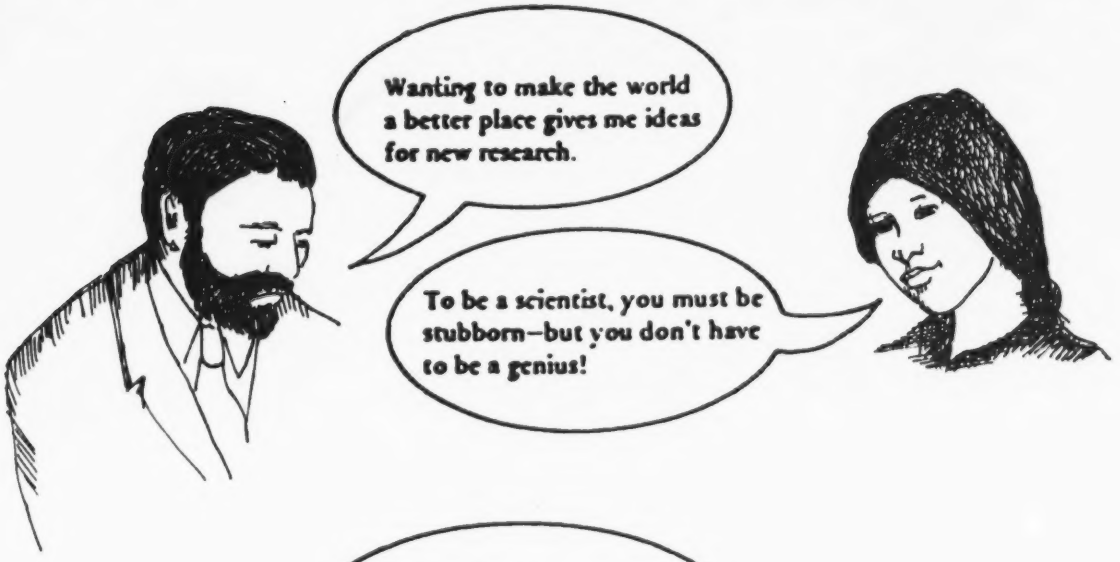
Form a group with three or four of your classmates.
Choose a group recorder to write your group's answers.

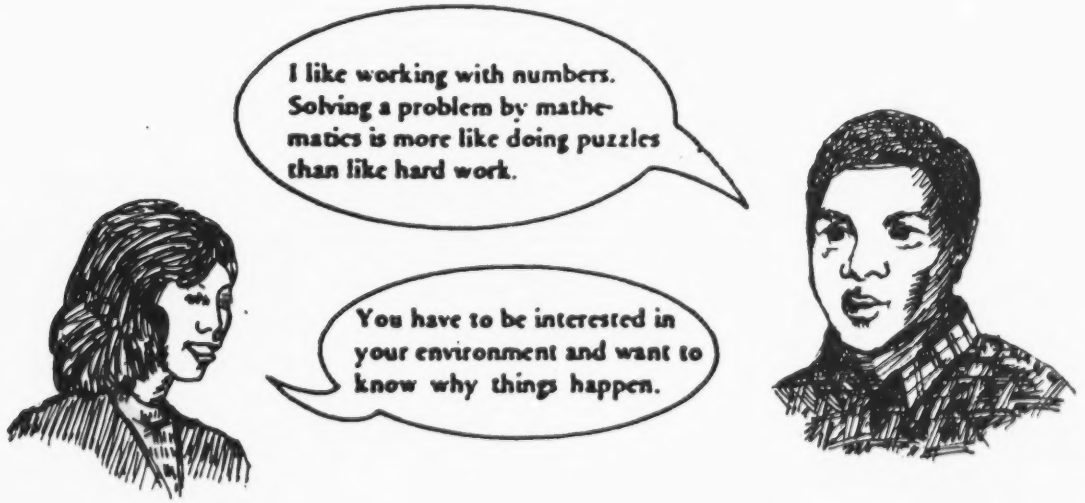
What do you think it takes to be a scientist or technologist? Do you have to be a genius?

Here's what some scientists have said about themselves.
Read each statement aloud in your group.

It takes a sense of adventure and a desire to help people.
You have to be a team player more than an individual. Scientific work takes a lot of cooperation.


When I was younger, I enjoyed taking things apart—I wanted to know how they worked.
If you can see things a little differently from everyone else, you can bring new ideas to science.


Wanting to make the world a better place gives me ideas for new research.
To be a scientist, you must be stubborn—but you don't have to be a genius!


I like working with numbers. Solving a problem by mathematics is more like doing puzzles than like hard work.
You have to be interested in your environment and want to know why things happen.

A-1 List characteristics that different scientists and technologists might have. Use the quotes on the two previous pages. It is doubtful that any one scientist has all of the characteristics described in the quotes, but list them anyway.

A-2 Who do you think is more likely to become a scientist?

a. Children who are encouraged to explore the out-of-doors, or children who are kept inside so they won't get hurt? Explain your answer.

b. Children who are encouraged to think for themselves, or children who are not allowed to do much of their own thing? Explain your answer.

c. Students who are encouraged to take math courses, or students who are encouraged to take English courses? Explain your answer.

d. Children who are encouraged to take things apart and put things together, or children who are discouraged from taking things apart? Explain your answer.

A-3 For each choice in questions a through d in A-2, who are more likely to do the activity: girls or boys?

A-4 Look at the following chart.

TOTAL WOMEN AND MEN IN SCIENCE LABOR FORCE (BY PERCENT)

	Women	Men
Physical sciences	9%	91%
Mathematics sciences	16%	84%
Computer sciences	17%	83%
Environmental sciences	4%	96%
Engineers	.5%	99.5%
Life sciences	13%	87%

a. What percentage of physical scientists are women? What percentage are men?

b. Which field has the largest percentage of women? Which field has the smallest percentage of women?

A-5 Why do you think more men than women choose science as a profession? Is this situation good? Why or why not?

ACTIVITY B:

B-1 Discuss your answers to A-1 through A-5.

B-2 What false ideas do you think people have about scientists?

B-3 Where do you think girls' and boys' attitudes about science come from?

B-4 What are some other differences in male and female attitudes and activities? How can you explain these differences?

B-5 Do you think boys and girls should be raised to act in different ways? Why or why not?

B-6 In 20 years, do you think the number of careers in science will greatly increase or greatly decrease? Explain. Why should this fact be important to both women and men?

LESSON PLAN

CHANGES

Read from the following list and have the students determine if they have the ability to change them or not.

1.	Color of hair	(can change; dye)
2.	How old you are	(cannot change)
3.	How strong you are	(can change)
4.	How well you listen	(can change)
5.	The direction of the wind	(cannot change)

Reasoning

Read the following questions to the class and have the pupils think of as many logical answers as possible. There is no one right answer, so encourage a variety of responses.

1. In a library books are sorted by author, subject or title. What other things are sorted in some way to organize them? (clothes in closet, drawer, food in a store, nails in hardware store, etc.)

2. If you were digging at the beach and hit something hard, what could it be? (box, rock, branch, etc.)

3. Moose and deer are alike in many ways; both have four legs and live on land. In what ways are they different? (size, where they live, etc.)

4. If Joey just ate a popsicle and you did not see him eat it, how could you tell he ate it? (popsicle stick, color on tongue or around mouth, etc.)

LESSON PLAN

CLASSIFICATION BY ALPHABET

Select one category from the list and have your students name the items in the category beginning with a, b, c,.... Some letters may need to be skipped (X).

1. things in a house (apple, bed, cup)
2. things in a school (atlas, book, chalk)
3. articles of clothing (apron, bikini, cap, dress)
4. animals (ant, bee, cobra, deer)

ORDER AND SEQUENCE

Give a list of items to the students to sequence. They must discover a method which makes sense, i.e. largest to smallest, loudest to quietest, hardest to softest. Start with three objects, then add more as they improve.

1.	dad, boy, grandpa	(grandpa, dad, boy...oldest to youngest)
2.	grandma, girl, mom	(girl, mom, grandma...youngest to oldest)
3.	night, morning, noon	(morning, noon, night...earliest to latest)
4.	dog, horse, mouse, whale	(whale, horse, dog, mouse...largest to smallest)

LESSON PLAN

COUNTLESS USES

PURPOSE: Enhance creative thinking abilities and classification skills.

GROUP SIZE: Small groups (4-5 per group)

TIME REQUIRED: 20 minutes

MATERIALS:
Acetate markers
Overhead
A variety of everyday materials:

cup	coat
chair	pencil
book	ring
broom	wastebasket
hat	clock

ROOM ARRANGEMENT: Small group setting, work tables

PROCEDURE:

1. Trainer holds up a pencil. Ask the entire group, "Tell me as many ways as you can think of to use this item."
2. Trainer then writes (or has picked a recorder from the group previously, to record) each answer as it is stated. (5 minutes)
3. Divide the group into small groups and give each group an object. Have them follow the same procedure to think of a wide variety of ways to use the object. A recorder from each group will write the responses. (5 minutes)
4. Each group will share their responses. Ask the whole group if they have additions. (10 minutes)
5. Discuss the purpose and results of using this activity to enhance creative thinking. Ask for other similar activities to enhance creative thinking in the classroom. Ask "Is creative thinking necessary in science?" (5-10 minutes)

COUNTLESS USES LIST

(Use this list in your classroom with your students and add to it.)

1. a plate
2. a typewriter
3. a shirt
4. a shoe
5. a tire
6. an eraser
7. a peanut
8. a pan
9. a nail
10. a light bulb
11. a button
12. a piece of paper
13. a vase
14. a truck
15. a fork
16. a spoon
17. a knife
18. a ladder
19. a crayon
20. scissors
21. a ruler
22. a glass
23. a calendar
24. a card
25. a boot
26. a lamp
27. a desk
28. a door
29. a doorknob
30. a salt shaker

LESSON PLAN

20 QUESTIONS

This is a good activity to assist students in being logical and putting the pieces together. They should start with broader questions and become more specific.

One student leaves the room as the others choose an object. The student must ask questions which can be answered with a yes or no.

Similarities

Ask the students how various items are alike. Encourage them to stretch their thinking. Pairs may be:

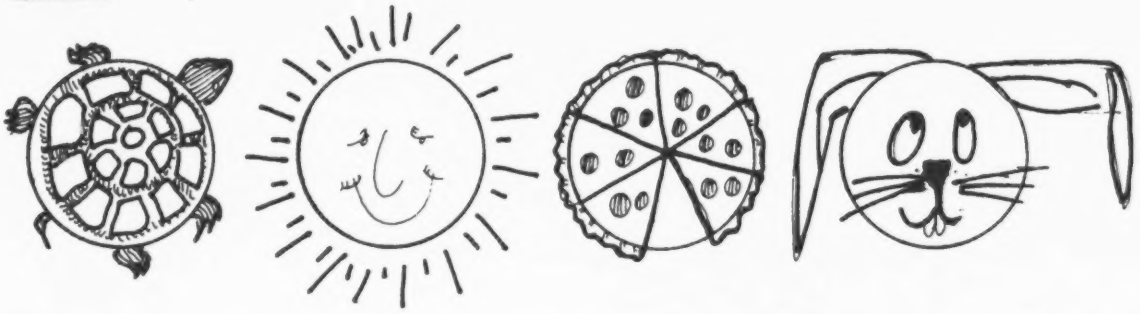
1. pencil, pen (both start with P, write with both)
2. coat, blanket (both used as a cover, both used by people, both used for warmth)
3. lamp, candle (both used for light, both can be used indoors and out)
4. lion, tiger (both have hair, both have four legs, both eat meat)

LESSON PLAN

SHAPES

This activity provides practice in creative thinking. Have each student draw 10 circles on a piece of paper. The students should make as many different drawings as they can.

Example



Then have the students do the same exercise using different shapes...triangle, square, rectangle, letters, etc.

WORDS

Challenge the students to determine a mystery word by listening to your clues. "I have a list of words, each starts with a "B."

1. To start is to _____. (begin)
2. An animal that stings is a _____. (bee)
3. To get to school, sometimes we ride a _____. (bus)
4. The color of the sky is _____. (blue)
5. Another word for twist is _____. (bend)
6. An animal that flies is a _____. (bird)
7. A long yellow fruit is a _____. (banana)
8. A house is a _____. (building)

LESSON PLAN

DESCRIBING

This activity will encourage the use of going beyond the usual descriptor words. The students should think of as many words as possible to describe an item.

Tell me how many ways can:

1. an animal feel (soft, cuddly, wet)
2. a school look (new, old, fresh, clean)
3. a person feel (happy, made, sad, old)
4. an animal move (run, hop, gallop, soar)
5. the weather feel (wet, hot, cool, damp)
6. food taste (sweet, sour, juicy)

WHAT WOULD YOU DO?

Tell the students a situation and have them visualize it. Have them tell what they would do using descriptive words for what they would see, smell, hear, touch, taste.

1. You are at the beach on a sunny day.
2. You see a fire in your kitchen.
3. You are in a huge candy store.
4. You are in a fancy restaurant.
5. You are caught in a snowstorm.

LESSON PLAN

Make a science poem using a popular song to help with rhythm.

FROSTY THE PHOTON
(to "Frosty the Snowman")

Frosty the Photon was quite a quantum sight,
With a zero mass and an endless life, and a speed approaching light.

There must have been some magic in a physics lab one year,
For when they studied X-ray beams, ole Frosty did appear.

Frosty the Photon says he knows he's not that large,
But he said one day if he comes this way, he will give us all a charge.

Thumpity thump thump, thumpity thump thump,
Moving fast as light.
Thumpity thump thump, thumpity thump thump,
Frosty's out of sight.

by Jim Muselino

HERE IN STATIC EQUILIBRIUM
(to "Winter Wonderland")

All my moments have canceled.
Sum of forces is equal.
I'm fully inert, and doing no work,
Here in Static Equilibrium.

Every push meets another.
Every pull has a counter.
The state, I allude, is true lassitude,
Here in Static Equilibrium.

All my forces balance out exactly.
You can even put me to a test.
Push me out in any old direction,
And you'll find I'll no longer be at rest.

Can't you see that I'm happy?
Sitting here, calm and mellow
Don't want to go home, so leave me alone,
Here in Static Equilibrium.

by Jim Muselino

Jim Muselino is a physics teacher and computer specialist at Valley High School, Stevenson Blvd., New Kingston, PA 15068.

SEX EQUITY LESSON PLAN

DEVELOPED BY:

SCHOOL:

GRADE LEVEL OR
TARGET GROUP:

TOPIC:

MATERIALS:

EXPECTED OUTCOMES:

PROCEDURE:

CLOSURE ACTIVITY FOR DEVELOPING LESSON PLANS

PURPOSE: To bring closure to the Lesson Plan Activity

GROUP SIZE: 10 to 30 people

TIME REQUIRED: 5 minutes

MATERIALS: Handout #9

ROOM ARRANGEMENT: Large Group

PROCEDURE: Trainer distributes Handout #9 and allows time for participants to review and comment if they wish on any of the listed activities.

ACTIVITIES FOR GRADES 1 - 6

1. Introduce students to biographies of women in science. Each student in turn can then develop a diorama, decorate a cake, make a mask, puppet or costume for one woman who especially captures her/his interest and do an explanatory presentation to the class. The entire assemblage can form the base for a school "women's history museum" in the classroom or library, with other classes invited to the opening ceremony and student-conducted tours. One class may do women in science, while another does women in math, etc.

2. Arrange for a storyteller or parent to dress in appropriate costume to circulate in your school telling stories about real American women in science, past or present. As a language arts exercise, the students might ask her questions about the stories, transcribing her responses for a class report.

3. Invite a woman working a non-traditional science job to share her experiences with your class. In advance, have the students prepare interview questions to ask her about the training her work required, what got her interested in this work initially, what she especially likes about the work she does, what its drawbacks are for her, and what her future plans are for her working life. A guessing game to determine just what her work is in the first place can be such, such as "Twenty Questions" or "What's My Line?"

4. Start a collection of pictures and articles from magazines, newspapers and advertisements depicting women in traditional and non-traditional science activities. Which are easier to locate? What are the adult women in your students' lives doing that the images represent? Create a mural telling the story of these lives and images to hang outside of your classroom for visitors and other students to see and consider.

5. Observe the birthdays of our foremothers in science throughout the year as you do our forefathers - special bulletin boards, classroom lessons, art projects, films, stories, skits. Birthday cakes decorated by the students to represent the life work of the birthday woman add to the impact and sense of importance, of course!

6. Announce a shoe box float contest and miniature parade on a selected theme dealing with women in United States science. A student committee can design, make and present ribbons to all participants, and announce each float during the parade.

7. "Piece" a quilt of construction paper collage squares, each depicting a scene from the life of a particular woman in science. Display these together on a dark background for maximum effect.

NATIONAL WOMEN'S HISTORY PROJECT
P.O. Box 3716
Santa Rosa, CA 95402
(707) 526-5974

ADDITIONAL RESOURCE & CLOSING ACTIVITY

PURPOSE: To bring closure to the day's events by given participants information on where to purchase additional resources on women in science.

GROUP SIZE: 10 to 30 people

TIME REQUIRED: 10 minutes

MATERIALS: Handouts #10, 11, 12, & 13 (optional)

ROOM ARRANGEMENT: Large or small groups

PROCEDURE:

1. Trainer distribute additional resources where participant can find information on women in science.
2. Trainer asks for participants to share science resources that have found to be especially educational in their classrooms.

RESOURCES

Handbook 1 Science Teaches Basic Skills
Handbook 2 The Principal's Role in Elementary School Science
Handbook 3 Characteristics of a Good Elementary Science Program
Handbook 4 What Research Says About Elementary School Science

Kenneth R. Mechling and Donna L. Oliver, National Science Teachers Association, 1742 Connecticut Avenue, NW, Washington, DC 20009.

School Science and Mathematics, Volume LXXIX, #4, April 1979

Science and Mathematics in the Schools: Report of a Convocation, National Academy of Sciences and Engineering

Yager, Robert E., What Research Says to the Science Teacher, N.S.T.A., University of Iowa, Iowa City, IA 52242, 1982

Science Education for the 1980s, California State Department of Education, 1982

Improving Math and Science Education, American Association of School Administrators, 1985

Educating Americans for the 21st Century, National Science board, 1983

Science Educational Society: A guide to Interaction and Influence, Abraham, Michael, University of Oklahoma, 1979

Women of Achievement, Susan Raven and Alison Weir, Harmony Books, New York, 1981

Studies in Science Education, Volume 4, 1977, Layton, David, Centre for Studies in Science Education, University of Leeds

Black, P. J., Pupils' Attitudes to Science, N.F.E.R. Publishing Co. Ltd., 2 Jennings Buildings, Thames Avenue, Windsor, Berkshire, England, $3.50

Science Education Data Bank, Directorate for Science Education, Office of Program Integration, Buccino, Alphonse

Johnson, Liz, Comp., and Hall, Roberta M. Comp., "Selected Activities Using 'The Classroom Climate: A Chilly One for Women?,'" Association of American Colleges, New York, NY 1984

Women's History Curriculum Guide and 1985-86 Resource Catalog ($1.00) National Women's History Project, P.O. Box 3716, Santa Rosa, CA 95402

Resources for Educational Equity, Women's Educational Equity Act Program, U.S. Department of Education

Resources to Counter Racism, Sexism and Other Forms of Bias in School and Society 1986 Catalog, Council on Interracial Books for Children, Inc.

Women, Math and Science; A Resource Manual, Center for Sex Equity in Schools, University of Michigan, 1984

Vetter, Betty. "Women in the Natural Sciences." Signs 1, Part 1 (Spring 1976) 713-720

Expanding Your Horizons in Science and Mathematics: A Handbook for Planners is a program to help educators and parents encourage young women to consider careers in science and technology. The handbook describes how to plan, conduct, and evaluate conferences for young women. "The Math-Science Connection" presents four exemplary programs for girls and women considering scientific or technical study. "Sandra, Zella, Dee, and Claire" takes a look at the scientific careers of four women - an astronomer, a veterinarian, a laser physicist, and an engineer. For middle and secondary school students. 0078 (50 pp.) $2.50

How High the Sky? How Far the Moon? An Educational Program for Girls and Women in Math and Science. Sure to pique students' interest, this program shows you how to teach science, and equity at the same time. The annotated list of materials for each grade will save you valuable planning time. If you're a math or science teacher, counselor, media specialist, librarian, or administrator, you and your students will find this an exciting addition to your curriculum. For grades K-12. 0103 "How High the Sky? How Far the Moon? (132 pp.) with "Women Scientist Today," four audiotape cassettes and guide. $14.50

Spatial Encounters is a classroom manual enabling fun and learning to come together. With these materials boys and girls enjoy visual-spatial games such as remembering patterns or completing and rotating figures. The exercises contain easy directions for classroom and self-directed use. They show how various visual-spatial skills have applications in the real world of scientific occupations - math, geography, acoustics, landscape architecture, and telecommunications. Particularly helpful for girls and women whose skills in these areas are often blunted by socialization and stereotyping. For grades K-12 and adults. 0434 "Spatial Encounters" (338 pp.). $14.00

RESOURCES

Science and Imagination: Some Further Reading

Combining lessons on science with activities in creative writing, art, and music is one way to increase your students' interest, enjoyment, and achievement. But other subjects can be combined, too. For suggestions, you might want to read some of the following articles:

Bybee, Roger W. "Creativity, Children, and Elementary Science," Science and Children 9:22-26, March 1972.

Cacha, Frances B. "Children Create Fiction Using Science." Science and Children 15:21-22, November/December 1977.

Day, Robert, ed. "Creative Writing in the Classroom." Urbana, IL: National Council of Teachers of English, 1978.

Ellman, Neil. "Science in the English Classroom." English Journal 67:63-65, April 1978.

Riley, Joseph, and K. D. Sowinski. "Natural Partners: Science and Reading." Science and Children 17:46-47, October 1979.

Simon, Marylu Shore, and Judith Moss Zimmerman. "Science and Writing." Science and Children 18:7-9, November/December 1980.

BOOKS FOR YOUNGER READERS

FOUR WOMEN OF COURAGE, Bennett Wayne, editor
True grit is what made Jacqueline Cochran, Dorothea Dix, Helen Keller, and Linda Richards famous. Young people who need encouragement to read will be inspired by their bravery. Photos. Grades 3-8. 168 pages, cloth, ISBN 0-8116-4911-3. $9.95

FIRST WOMEN OF THE SKIES, Kitty A. Crowley
Brief, interesting looks at the lives of five women pioneers in aviation: Bessie Coleman, Mathilda Moisant, Harriet Quimby, Valentina Tereshkoba and Emily Warner. Grades 3 and up. 48 pages, cloth, ISBN 0-89547-063-2, $10.95

WOMEN WHO DARED TO BE DIFFERENT, Bennett Wayne, editor
Easy-to-read detailed life stories of daring women from earlier times: Nelly Bly, reporter; Amelia Earhart, pilot; Maria Mitchell, astronomer; and Annie Oakley, sharpshooter. Photographs. Grades 3-8. 168 pages, cloth, ISBN 0-8116-4902-4, $9.95

WOMEN WITH A CAUSE, Bennett Wayne, editor
The lives of Susan B. Anthony, Anne Hutchinson, Lucretia Mott, Eleanor Roosevelt, and the causes they championed are the subjects of this easy-to-read volume. Photos. Grades 3-8. 168 pages, cloth, ISBN 0-8116-4914-8, $9.95

TATTERHOOD AND OTHER TALES, Ethel Johnston Phelps, editor
All the central characters in these 25 international folk tales are spirited females - decisive heroines of courage, wit and achievement who set out to determine their own fate. Includes details about their sources. Illustration. Grades 1-6. 166 pages, paper, ISBN 0-912670-50-9, $6.95

RACHEL CARSON: WHO LOVED THE SEA, Jean Lee Latham
Carson's love for the ocean and biology led her to become a scientist, while her clear writing helped awaken the world to the destructiveness of pesticides. Photos. Grades 2-5. 80 pages, cloth, ISBN 8116-6312-4, $8.95

LILIUOKALANI, Mary Malone
This biography of Hawaii's last sovereign, Queen Liliuokalani, gives young readers a full picture of her life as an educator and her short, stormy career as a monarch. Illustrations. Grades 2-5. 80 pages, cloth, ISBN 0-8116-6320-5, $8.95

ELIZABETH BLACKWELL: PIONEER WOMAN DOCTOR, Jean Lee Latham
In 1849 Blackwell became one of the first women allowed to earn a medical degree in the U.S. She went on to work as a physician and to found a hospital and medical college for women in New York. Illustrated. Grades 2-5. 80 pages, cloth, ISBN 0-8116-6319-1, $8.95

EMBERS, Ruth Meyers and Beryle Banfield, editors
Lively fiction, biography, poetry and oral histories portray people who in various ways overcame traditional barriers of race, sex and disability. Illustrations. Grades 3-7. 175 pages, paper, ISBN 0-9300040-47-3, $8.95

EMBERS, TEACHER EDITION, Ruth Meyers and Beryle Banfield, editors
Provides a teacher/learning plan for each selection in the reader. Activities will assist students in exploring concepts of justice, equality, family culture and tradition as well as developing reading and language arts proficiency. Grades 3-7. 142 pages, spiral bound. ISBN 0-9300040-46-5, $18.95

WOMEN, NUMBERS AND DREAMS, Teri Hoch Perl and Joan M. Manning
Math puzzles, activities and illustrations accompany each of the thirteen biographical sketches of women mathematicians. Multicultural and marvelous! Who's included? Lenore Blu, Mary Everett Boole, Jean Darling, Kathi Dwelle, Evelyn Boyd Granville, Sally Handy-Zarnstorff, Sonya Kovalevskaya, Ada Lovelace, Fanya S. Montalvo, Emmy Noether, Edna Lee Paisano, Mary Somerville and Grace L. Yang. A separate 21 page teacher's manual accompanies the book. Grades 3-6. 257 pages, paper, $12.95 set

MYSELF AND WOMEN HEROES IN MY WORLD: A CURRICULUM UNIT FOR KINDERGARTEN,
National Women's History Project, Illustrated by Mary Crawford
Marvelous flannel board figures accompany each of the six lively biographies, as do recall and discussion questions, specifically related activities, a teacher bibliography and culminating unit activity. In all, these materials will bring to life the six women of this unit for young children: Queen Liliuokalani, the last reigning Monarch of Hawaii; Maria Tallchief, world famous prima ballerina; Harriet Tubman, slave liberator of the Underground Railroad; Amelia Earhart, adventuresome pilot; Sonia Manzano, stage and television personality; Sojourner Truth, fearless speaker for human rights. A personal history activity concludes the unit, drawing connections between the life choices of the child and the lives of these six remarkable women. 68 pages, paper, $7.50

WOMEN'S HISTORY CURRICULUM UNITS FOR GRADES 1, 2 and 3
National Women's History Project, Illustrated by Mary Crawford
Specially designed in accordance with social studies guidelines, these units each include 6 biographies and illustrations of women representing the 5 major ethnic groups and disabled persons, plus classroom and individual activities, language and math exercises, and oral history kits.

RESOURCES - FILMSTRIPS

CHILDCARE SHAPES THE FUTURE: Anti-Sexist Strategies

The first part of this filmstrip discusses how our expectations determine treatment of boys and girls and set up role models of boys as aggressive and inquisitive and girls as gentle and docile. Part two outlines ten anti-sexist childcare strategies and gives good suggestions to help educators become more sensitive to their role in creating an anti-sexist environment.

Contents: 2 sound-color filmstrips and 2 cassettes (the first strip is 93 frames and 12 minutes, the second is 118 frames and 15 minutes); a booklet with scripts, research studies and recommended reading; plus an 8-page Report Card. LC 81-730652, $45

AND THEN WHAT HAPPENED? Ten unique short-story filmstrips with 15 cassettes and a detailed Teacher Guide.

Designed to develop critical thinking about the behavior of men, women and children. The filmstrip stories encourage children to think about their own values and their own behavior. Tested in kindergarten through 4th grade lasses in inner-city and suburban schools, each filmstrip provides the teacher with guides for three discussion periods - pre-showing, mid-showing, and post-showing.

Discussion guides and activities are adjusted for age levels. The discussions on "adult" topics are certain to interest and challenge the children. The overall purpose is to develop girls' self-esteem and desire for economic independence, while developing boys' greater respect for girls and women.

1. EQUAL PLAY: children challenging the lack of sex equity in an after-school play center.

2. EQUAL PAY: a working mother's decision to join a strike in an effort to be paid as much as the male workers earn.

3. EQUAL CHANCE: a teenaged girl decides about remaining in an auto-mechanic class despite her boyfriend's disapproval.

4. EQUAL HOUSEWORK: a single mother and her children decide whether or not she should marry a man who believes in strict traditional sex roles.

5. WHAT KIND OF MAN? two boys argue about what type of ideal man each prefers - macho versus kind and considerate.

6. NO TOUCHING: two children are pursued by a child molester at the movies and are then provided with some coping strategies by a relative.

7. SKIN DEEP: two dark-skinned Black children feel that teachers and other Black children show preference for lighter-skinned Blacks.

8. NO HURTING: a boy whose father is a wife and child batterer discusses the situation with a friend's family.

9. BABIES ARE NOT TOYS: two girls have opposite ideas about their older sisters becoming teenaged mothers.

10. EQUAL PROMISES: a child and a man discuss the desirability of a marriage contract that emphasizes shared roles and responsibilities.

The first five filmstrips are accompanied by <u>two</u> cassettes. One has a narrator who makes it easier for younger children to comprehend the presentation. After seeing the first five filmstrips, it was found that the children were able to follow the remaining five without the narrator. We recommend that the cassettes <u>with</u> the narrator be used for kindergarten and first grades. Second graders seem able to understand either type of cassette. For third and fourth grades, the cassettes <u>without</u> a narrator are more suitable. LC 83-730283

The entire unit - 10 filmstrips, 15 cassettes and a Teacher Guide - $110.00. Individual filmstrips, $24.95 each. Any five, $79.95.

COUNT ME IN: EDUCATING WOMEN FOR SCIENCE AND MATH

The Women in Science program at Mills College led to a dramatic increase in student enrollment in math and computer science courses. Learn how the program did it. "Count Me In" is designed for science classes and career workshops.

Project Director: Dr. Lenore Blum, Center for Career and Life Planning and Department of Mathematics/Computer Science, Mills College, Oakland, California. Film Producer and Director: Peter Abramowitsch.

FOR: Secondary school students.

"Count Me In: Educating Women for Science and Math," videotape cassette (black and white, 3/4 inch, 30 minutes; brochure included)

0160 Purchase $36.00
0161 Rental (3 days) $6.00

Expanding Your Horizons in Science and Mathematics: A Handbook for Planners is a program to help educators and parents encourage young women to consider careers in science and technology. The handbook describes how to plan, conduct, and evaluate conferences for young women. "The Math-Science Connection" presents four exemplary programs for girls and women considering scientific or technical study. "Sandra, Zella, Dee, and Claire" takes a look at the scientific careers of four women - an astronomer, a veterinarian, a laser physicist, and an engineer.

FOR: Middle and secondary school students. 0078 (50 pp.) $2.50

"THE MATH SCIENCE CONNECTION: EDUCATING YOUNG WOMEN FOR TODAY"

16mm film (color, 18 minutes)
0079 Purchase $115.00
0080 Rental (3 days) $8.00

Videotape cassette (color, 3/4 inch, 18 minutes)
0081 Purchase $32.00
0082 Rental (3 days) $8.00

"SANDRA, ZELLA, DEE, AND CLAIRE: FOUR WOMEN IN SCIENCE,"

16 mm film (color, 19 minutes)
0083 Purchase $120.00
0084 Rental (3 days) $8.00

Videotape cassette (color, 3/4 inch, 19 minutes)
0085 Purchase $32.00
0086 rental (3 days) $5.00

HANDOUT #13
(Optional)

Anchorage School District

MAIN AND SUPPLEMENTAL SCIENCE KITS

K - 3

GRADE	MAIN KITS	SUPPLEMENTAL KITS	
Kdg.	Dinosaurs Five Senses	Observing Plants Tanagrams	Growing Seeds Offalot
Modified Primary	Sink or Float Radishes & Rutabagas Material Objects Shells	Same as Kindergarten and First Grade	
First	Magnets Mini-Beasts (Insects) Weather Plants	Organisms Brine Shrimp Geoblocks Brightland	Match & Measure Mirror Cards Attribute Games "Sea Animals" Notebook
Second	Water Properties of Sound Birds of Anchorage Alaskan Animals	Interaction and Systems Life Cycles	Clay Boats Structures
Third	Mystery Powders Weather Alaskan Plants & Trees Simple Machines	Subsystems and Variables Populations	Drops, Steams and Containers

EVALUATION

PURPOSE: To solicit feedback from participants on the content and organization of the workshop.

GROUP SIZE: 10 to 30

TIME REQUIRED: 5 minutes

MATERIALS: Handout #14 (or school district's evaluation tool)

PROCEDURE:

1. Inform participants that they now will have an opportunity to evaluate the workshop.

2. Distribute Handout #14 and allow 10 minutes for participants to complete evaluation.

3. Ask participants to place evaluations on a table as they leave the workshop.

4. While participants are completing their evaluation forms, it would be a good time for the Trainer to complete the Trainer's Module Evaluation found at the end of this module. Once completed, please return to:

   Sex Equity Coordinator
   Department of Education
   P.O. Box F
   Juneau, AK 99811-0500

   In Anchorage send the completed form to:

   Anita Robinson
   Community Relations Department

   Thank you!

Anchorage School District Trainers substitute ASD evaluation form for this page.

WORKSHOP EVALUATION

I. How would you rate this workshop in the following areas?

(Please circle the most appropriate rating)

		Very Clear				Not Clear
A.	Objectives were made clear.	1	2	3	4	5
		To a great extent				Not Met At All
B.	Objectives were met.	1	2	3	4	5
		Great Value				No Value
C.	Information was of practical value.	1	2	3	4	5
		Most Relevant				Not Relevant
D.	Handouts/materials were relevant to my present needs.	1	2	3	4	5
		Highly Effective				Not Effective
E.	Presentation was effective.	1	2	3	4	5

II. Circle one of the following ratings which best describes your feeling about this workshop in comparison to others you have attended?

1 One of the Best

2 Better Than Most

3 About Average

4 Weaker Than Most

5 One of the Worst

What were the strongest features of the workshop? _____

_____

What were the weakest features of the workshop? _____

_____

TRAINER'S MODULE EVALUATION

TRAINER NOTE: Now that you have completed the workshop, please take a moment to complete the following evaluation. Your input will be of vital importance as the modules are refined to meet the needs of teachers.

YOUR NAME: (optional) _____

NAME OF MODULE: _____

WHERE PRESENTED: _____

NUMBER OF PARTICIPANTS: _____

I. Trainer Instruction Sheet

A. Were trainer instructions clear and precise? _____ YES _____ NO

If no, please state page number and problem area: _____

_____

Other comments: _____

_____

B. Was the format of the Trainer Instruction Sheets easy to follow?

_____ YES _____ NO

II. Participant Activities

A. Which activity did the participants appear to enjoy the most? _____

_____

B. Are there any activities that you feel need to be eliminated or replaced? If so, please identify. _____

_____

C. Was the timing allocated for activities appropriate?

_____ YES _____ NO

D. Overall, do you feel this module raised the participants' awareness of sex bias?

_____